NUCLEAR SCIENCE ABSTRACTS

Volume 29 Number 7

Abstracts 15205-18027

April 15, 1974

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Volume 29, Number 7, April 15, 1974

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the USAEC Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multi-volume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415 (DP-MS-72-48)
CRAWFORD, J.F, Electron multiplication in cavities, 28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTORS/RESEARCH PROGRAMS
Institute of Nuclear Research two-year-book, 1970--1971, 28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
Perturbing aspects of the companions of Barnard's star, 28:19287
REFRACTORIES/ELECTRON MICROSCOPY
Electron microscope for investigation of metals at high temperature, 28:18834

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

19981 (ORNL-4804) ^{238}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
^{238}U neutron elastic-scattering cross sections from 6.44 to 8.56 MeV, 28:19981 (ORNL-4804)
Analytical techniques for determining levels and fates of trace elements in a fossil-fueled steam plant, 28:17850 (CONF-730817-1)

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 16397, 16400, 16405, and 17093.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 15804, 16066, 16088, and 16111.

15205 (AECL-4581) NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS OF SILICON CARBIDE. Vandergraaf, T. T.; Wikjord, A. G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Oct 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25. AECL $1.00.

Instrumental neutron activation analysis was used to determine trace constituents in silicon carbide. Four commercial powders of different origin, an NBS reference material, and a single crystal were characterized. A total of 36 activation species were identified nondestructively by high resolution γ spectrometry; quantitative results are given for 12 of the more predominant elements. The limitations of the method for certain elements are discussed. Consideration is given to the depression of the neutron flux by impurities with large neutron absorption cross sections. Radiation fields from the various specimens were estimated assuming all radionuclides have reached their saturation activities. (auth)

15206 (BNWL-SA-4726) DETECTION SYSTEMS FOR THE LOW-LEVEL RADIOCHEMICAL ANALYSIS OF IODINE-131, IODINE-129, AND NATURAL IODINE IN ENVIRONMENTAL SAMPLES. Brauer, F. P.; Kaye, J. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 26 Oct 1973. Contract AT(45-1)-1830. 26p. (CONF-731112-22). Dep. NTIS $3.50.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A procedure based on chemical separation techniques and activation analysis was developed for the sequential analysis of low levels of ^{131}I, ^{129}I, and natural iodine in environmental samples. The iodine is first separated from the samples by oxidation. The separated iodine is then counted by low-level, beta-gated gamma spectrometry for the measurement of ^{131}I. The chemical yield for the separation is measured by means of ^{125}I tracer. Activation analysis is used for measurement of the separated natural iodine (^{127}I) and ^{129}I. The natural iodine is estimated from either the ^{126}I or ^{128}I activity produced in the sample; the induced ^{130}I is used to estimate the ^{129}I concentration. The measurement of ^{130}I at low levels requires specialized counting methods. Interfering activities that may be present in the irradiated sample include ^{125}I, ^{126}I, short-lived fission-product iodine activities produced by activation of uranium impurities, and ^{82}Br from bromine impurities. Since ^{130}I decays with several coincident gamma rays, multiple gamma coincidence counting techniques can be used to reduce background and discriminate against interfering activities. Several three- and four-segmented NaI(Tl) detectors were used for these measurements and compared with other detector systems. The sensitivities for different coincidence counting modes were compared for several of the detector systems. Detection sensitivities achieved for ^{131}I and ^{129}I are 0.02 dpm and 10^{-6} dpm, respectively. Measurements have been made of iodine radioactivity in the environment at concentrations below the limits established for radiation protection purposes. (auth)

15207 (EURISOTOP-72) NUCLEAR ANALYSIS TECHNIQUES IN THE PRODUCTION AND INDUSTRIAL USE OF NOBLE METALS. Symposium Held in Brussels, November 16–17, 1971. Schmitt, B. F. (comp.). (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1973. 610p. (In Several Languages). (CONF-711132–).

Twelve papers were presented at the symposium and separate abstracts have been prepared for seven of them. Five of the papers were previously abstracted for NSA and appeared as 26: 25164, 27739, 27740, 27741, and 27742. (LK)

For abstracts of individual papers see: 15208, 15274, 15275, 15309, 15310, and 15804.

15208 (EURISOTOP-72, pp 359-373) COINCIDENCE GAMMA SPECTROMETRY FOR USE IN SUBMICROANALYSIS OF NOBLE METAL TRACES. Quandt, U.; Herpers, U. (Univ., Cologne). 1973. (In German).

From symposium on nuclear analysis techniques in the production and industrial use of noble metals; Brussels, Belgium (16 Nov 1971).

A coincidence γ spectrometer was developed for the neutron activation determination of traces of Ir in meteorites and terrestrial minerals and rocks. The procedure for the Ir determination is given and the results of test runs on various types of samples are tabulated. (JSR)

15209 (EURISOTOP-72, pp 375-439) ACTIVATION ANALYSIS BY MEANS OF CHARGED PARTICLES AND GAMMA PHOTONS IN THE NOBLE METAL INDUSTRY (Ru, Rh, Pd, Ag, Os, Ir, Pt, AND Au). Engelmann, C. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In German).

From symposium on nuclear analysis techniques in the production and industrial use of noble metals; Brussels, Belgium (16 Nov 1971).

The practical and theoretical possibilities of activation analysis in the noble metal industry are discussed. The various types of activation are described. The possibilities offered in the determination of noble metals in ores and stamp pulp by the use of charged particle and gamma photon activation are summarized. The use of these techniques for the determination of impurities in the noble metals is discussed. The special case of surface analysis is considered. A review and critical analysis are given of publications in this area. (JSR)

15210 (IAEA-157) TRACE ELEMENTS IN RELATION TO CARDIOVASCULAR DISEASES. Papers Presented at a Research Coordination Meeting, Vienna, Austria, February 19–23, 1973. (World Health Organization, Geneva (Switzerland); International Atomic Energy Agency, Vienna (Austria)). 1973. 225p. (CONF-730224–).

Separate abstracts were prepared for 18 of the 19 papers presented in these proceedings. The other paper discusses chromium in refined and unrefined sugars from various countries as analyzed by flameless atomic absorption. An abstract was also prepared for the summary report and recommendations resulting from the meeting. An appendix is included that contains the research protocols that have been in use for the two main autopsy projects. (ERB)

For abstracts of individual papers see: 15211–15229.

15211 (IAEA-157, pp 1-3) NEUTRON ACTIVATION AND ATOMIC ABSORPTION ANALYSIS OF 9 ELEMENTS IN RELATION TO A STUDY OF TRACE ELEMENTS IN CARDIOVASCULAR DISEASES. Boddy, K.; East, B. W. (Scottish Universities Research and Reactor Centre, East Kilbride, Scotland). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods employed for the elemental analysis of human tissue samples are described. Seven elements (Cd, Cl, Cr, Cu, Mn, Na, and Zn) are determined by a combination of destructive and non-destructive neutron activation analysis; two elements (Ca and Mg) are determined by atomic absorption spectrophotometry. (auth)

15212 (IAEA-157, pp 5-12) NEUTRON ACTIVATION ANALYSIS AND ATOMIC ABSORPTION ANALYSIS OF 18 ELEMENTS IN RELATION TO A STUDY OF TRACE ELEMENTS IN CARDIOVASCULAR DISEASES. Brill, A. B. (Vanderbilt Univ., Nashville); Page, D.; Dyer, N.; Baglan, R.; Lyon, W. S. 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods employed for the elemental analysis of human tissue samples are described. Fifteen elements are determined by instrumental neutron activation analysis and three elements by atomic absorption spectrophotometry. These methods were tested with the aid of an NBS standard analytical reference material, SRM 1577, and have been used for the analysis of a small number of human heart samples. Preliminary results are presented. (auth)

15213 (IAEA-157, pp 13-18) NEUTRON ACTIVATION ANALYSIS OF TEN ELEMENTS IN RELATION TO A STUDY OF TRACE ELEMENTS IN ISCHAEMIC HEART DISEASES. Christov, C.; Donev, I. I. (Bulgarian Academy of Sciences, Sofia). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods used in our laboratory for the elemental analysis of human tissues are described. Instrumental thermal neutron activation analysis was employed for the analysis of up to 10 elements: Br, Cd, Cl, Cr, Cu, Fe, K, Mn, Na, and Zn. Results are presented for the NBS analytical reference material, bovine liver (SRM 1577) and for a number of organs obtained from two cardiovascular disease patients. (auth)

15214 (IAEA-157, pp 19-27) NEUTRON ACTIVATION ANALYSIS OF COPPER, MOLYBDENUM, AND ZINC IN RELATION TO A STUDY OF TRACE ELEMENTS IN CARDIOVASCULAR DISEASES. de la Cruz, B. (Philippine Atomic Energy Commission, Quezon City). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

An investigation of the possible role of trace elements in the aetiology of certain types of cardiovascular disease which is being undertaken at the Philippine Atomic Research Center in collaboration with WHO, IAEA, and, in the Philippines, the National Bureau of Investigation, the Veterans Memorial Hospital, and the Rural Health Units of the Department of Health is described. The analytical method, which makes use of post-irradiation chemistry based mainly on ion-exchange and precipitation, is described. Preliminary results are reported for Cu, Mo, and Zn in heart, liver, kidney, blood, and standard reference material (Bowen's kale). (auth)

15215 (IAEA-157, pp 29-49) NEUTRON ACTIVATION ANALYSIS METHODS FOR THE DETERMINATION OF 14 TRACE ELEMENTS IN TISSUE SAMPLES. Results Obtained with Analytical Reference Materials. Grimanis, A. P.; Papacostidis, G.; Papadopoulou, C.; Vassilaki-Grimani, M.; Papacharalambus, N.; Plassaras, G.; Kotoulas, D. (Democritos Nuclear Research Center, Athens). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods are described for the determination of fourteen trace elements in a bovine liver analytical reference material by neutron activation analysis. Nine elements (Cl, Co, Cu, Fe, K, Mg, Mn, Na, and Zn) were determined by instrumental neutron activation analysis using a Ge(Li) detector coupled with a 4000 channel analyzer. For the determination of the other five elements (As, Cd, Cr, Mo, and Se), fast radiochemical separations based on solvent extraction or ion exchange techniques combined with neutron activation analysis methods were used. The same 14 elements were also determined in NBS standard reference material 1571 (orchard leaves) and in a standard biological material (kale) and the results are reported. These intercomparisons aimed at providing an independent check on the accuracy and precision of the analytical methods used by participants in the WHO/IAEA joint research program on trace elements in cardiovascular diseases. (auth)

15216 (IAEA-157, pp 51-56) DETERMINATION OF CADMIUM AND ZINC IN KIDNEY AND LIVER TISSUE BY NEUTRON ACTIVATION ANALYSIS. Johansen, O.; Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods used for the analysis of cadmium and zinc by radiochemical neutron activation analysis are presented. Two radiochemical procedures, both based on anion exchange, have been developed and tested by the use of NBS bovine liver, SRM 1577, and Bowen's kale. A small number of autopsy samples of human liver, kidney cortex and kidney medulla have also been analyzed, and preliminary results are presented. (auth)

15217 (IAEA-157, pp 57-69) ANALYSIS OF TRACE ELEMENTS IN HUMAN TISSUE AND AN ADDENDUM ON CHRONOBIOLOGY. Kanabrocki, E. L. (Veterans Administration Hospital, Hines, IL). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods employed for the elemental analysis of human tissue samples are described. Thirteen elements are determined by instrumental neutron activation analysis and three elements by atomic absorption spectrophotometry. Tissues analyzed include fingernails, heart, aorta, lung, liver, spleen, and pituitary. In an addendum, circadian patterns in blood pressure, serum cholesterol, and zinc excretion are discussed. (ERB)

15218 (IAEA-157, pp 71-76) ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF 15 ELEMENTS IN CONNECTION WITH THE WHO/IAEA JOINT RESEARCH PROGRAMME ON TRACE ELEMENTS IN CARDIOVASCULAR DISEASES. Kasperek, K.; Schicha, H.; Weese, H. (Kernforschungsanlage, Juelich, Ger.). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods employed for the analysis of human tissue samples are described. Thirteen elements are determined by instrumental thermal neutron activation analysis and two elements, Cd and Cu, are determined by destructive activation analysis. These methods were tested with the aid of an NBS standard analytical reference material, SRM 1577, and have been used for the analysis of heart tissue samples supplied by WHO/IAEA. Preliminary results are presented. (auth)

15219 (IAEA-157, pp 87-90) IAEA LABORATORY ACTIVITIES IN SUPPORT OF THE WHO/IAEA JOINT RESEARCH PROGRAMME ON TRACE ELEMENTS IN CARDIOVASCULAR DISEASES. Parr, R. M. (IAEA, Vienna). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

A brief description is given of the facilities available for medical activation analysis in the IAEA laboratory and of the research and development work undertaken there in support of the WHO/IAEA joint research program on trace elements in cardiovascular diseases. (auth)

15220 (IAEA-157, pp 91-102) MULTIELEMENT NEUTRON ACTIVATION ANALYSIS IN RELATION TO A STUDY OF TRACE ELEMENTS IN CARDIOVASCULAR DISEASES. Plantin, L. O. (Research Inst., Stockholm). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods employed for the analysis of human tissue samples are described. More than 20 elements are determined by destructive neutron activation analysis based on post-irradiation radiochemistry and Ge(Li) gamma-ray spectrometry. The radiochemical separation scheme utilizes mainly ion exchange. Results are presented for the NBS bovine liver analytical reference material, SRM 1577, as well as for a small number of heart, liver, and kidney cortex samples obtained from patients that died with myocardial infarction. (auth)

15221 (IAEA-157, pp 103-122) ELEMENTAL ABUNDANCES IN TOENAILS, SUGAR, AND RICE BY NEUTRON ACTIVATION ANALYSIS AND ATOMIC ABSORPTION. Pierce, J. O.; Abu-Samra, A.; Fehlauer, D.; Clevenger, T.; Vogt, J. (Univ. of Missouri, Columbia). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Elemental abundances in toenails, sugar, and rice were determined using neutron activation analysis and atomic absorption. In addition, data for selected elements in Bowen's kale and National Bureau of Standards (NBS) samples of bovine liver and orchard leaves are also presented. Instrumental neutron activation analysis was used to determine Al, Ca, Cl, Cu, K, Mg, Mn, Na, V, and S in toenails; Na, Mg, Al, S, Cl, K, Ca, V, Mn, Cu, Br, and Sr in Bowen's kale; and Na, Mg, Al, Cl, K, Ca, V, Mn, Cu, As, Br, and La in orchard leaves. Radiochemical separations were used to determine Cr in sugar, rice, and bovine liver. Atomic absorption was used to determine Cu and Zn and upper limits for Cd in sugar and rice, and to determine Zn, Cu, Cd, Pb, Fe, Na, K, and Mn in Bowen's kale and NBS bovine liver. (auth)

15222 (IAEA-157, pp 123-132) NEUTRON ACTIVATION ANALYSIS OF 12 ELEMENTS IN RELATION TO A STUDY OF

TRACE ELEMENTS IN CARDIOVASCULAR DISEASES. Rudelli, M. D.; Rocca, H. C.; Korob, R.; Dezzutti, J. C. (Comision Nacional de Energia Atomica, Buenos Aires). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Methods employed for the analysis of trace elements in human tissues are described. Up to 12 elements can be determined by a combination of instrumental and destructive neutron activation analysis. Radiochemical separations are accomplished mainly by ion-exchange methods. Some of the possibilities of epithermal neutron activation analysis are discussed. (auth)

15223 (IAEA-157, pp 133-141) AUTOMATED SOLVENT EXTRACTION APPARATUS AND RADIOCHEMICAL SEPARATION SCHEME FOR THE DETERMINATION OF CADMIUM, CHROMIUM, COPPER, MOLYBDENUM, AND ZINC IN BIOLOGICAL MATERIALS. Trowell, F.; Herrington, J.; Goode, G. C. (Atomic Weapons Research Establishment, Aldermaston, Eng.). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

An automatic solvent extraction apparatus that permits two samples at a time to be subjected to a sequence of solvent extraction steps designed to produce a number of extracted fractions, each containing one or more elements is described. A radiochemical separation scheme developed for this apparatus permits the determination of cadmium, chromium, copper, molybdenum, and zinc in biological materials by thermal neutron activation analysis. (auth)

15224 (IAEA-157, pp 143-148) RADIOCHEMICAL SEPARATIONS IN MULTIELEMENT NEUTRON ACTIVATION ANALYSIS OF HUMAN TISSUES. Parr, R. M. (IAEA, Vienna). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

A theoretical analysis is presented of the applicability of instrumental thermal neutron activation analysis (ITNAA), based on the use of a Ge(Li) detector, for the determination of trace elements at their natural concentrations in human tissues. Simplified schematic γ-ray spectra of two typical tissues, liver and blood serum under different conditions of activation and decay, are presented. It is concluded that ITNAA is generally applicable only to about 8 elements, Br, Cl, Fe, K, Na, P, Rb, and Zn. A further group of elements, principally Ag, Ca, Cd, Co, Cr, Cs, Hg, I, Mn, Sc, and Se can be determined by ITNAA in some but not all tissues. For these latter elements and other elements not listed above, radiochemistry must be employed in any analytical method that is intended to be of general applicability. (auth)

15225 (IAEA-157, pp 149-154) DEVELOPMENT OF A GROUP SEPARATION SCHEME FOR THE DETERMINATION OF TRACE ELEMENTS IN BIOLOGICAL TISSUE BY NEUTRON ACTIVATION ANALYSIS. Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

This is a preliminary report on a radiochemical separation scheme proposed for the multielement activation analysis of biological materials. Solvent extraction, precipitation, anion exchange, and distillation form the basis of the scheme. Three different activation-decay-radiochemistry combinations are foreseen: for the analysis of V and Mg; for the analysis of Mn, Cu, In, and Ni; and for the analysis of Hg, As, Se, Zn, Cd, Mo, W, Se, Fe, Co, Re, Cr, Ba, Sr, and Rb. The scheme has been tested by the use of NBS bovine liver, SRM 1577, and Bowen's kale, and preliminary results for these materials are presented. (auth)

15226 (IAEA-157, pp 155-162) RADIOCHEMICAL MACHINE FOR THE ANALYSIS OF Cd, Cr, Cu, Mo, AND Zn. Samsahl, K.; Wester, P. O.; Blomqvist, G. (Aktiebolaget Atomenergi, Studsvik, Sweden). 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

A fast automatic radiochemical machine for the determination of Cd, Cr, Cu, Mo, and Zn in biological material was developed. The method is based on ion-exchange separation combined with gamma spectrometry. The precision of the machine was studied both with added activities and with repeated analysis of the same sample (human heart tissue). The standard deviation of a single value was in both cases <3%. (auth)

15227 (IAEA-157, pp 163-173) ENVIRONMENTAL/OCEANOGRAPHIC NEUTRON ACTIVATION ANALYSIS TRACE ELEMENT STUDIES. Guinn, V. P. (Univ. of California, Irvine); de Goeij, J. J. M. 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Earlier instrumental neutron activation analysis (NAA) studies of trace elements in fish samples showed that levels of Hg, Se, and Zn as low as 0.02, 0.02, and 0.2 ppM, respectively (wet-tissue) could be detected. In a more extensive study of trace elements in marine biological samples, a group radiochemical separation scheme has been employed that is based upon volatilization of the bromides of Hg, Se, As, and Sb; removal of sodium from the residue by hydrated antimony pentoxide; and ion exchange. The analytical method, which also relies on Ge(Li) γ-ray spectrometry, provides good precision and accuracy for the determination of 12 trace elements of interest in fish-liver samples: As, Au, Cd, Co, Cr, Cu, Fe, Hg, Mo, Sb, Se, and Zn. (auth)

15228 (IAEA-157, pp 175-189) ANALYTICAL QUALITY CONTROL FOR THE WHO/IAEA JOINT RESEARCH PROGRAMME ON TRACE ELEMENTS IN CARDIOVASCULAR DISEASES (AUTOPSY STUDIES). Report of an IAEA Consultants' Meeting. 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

A framework is proposed for a program of quality control intended for use by analytical laboratories participating in a joint WHO/IAEA research program. The purposes of quality control in this program are: (1) to provide a level of analytical precision such that the relative standard deviation of a single result (not including any contribution from counting statistics) does not exceed 10%, and (2) to provide a level of accuracy, as established by the analysis of standard reference materials, that lies within the same limits. Means for achieving these aims include quality control of pre-analysis procedures and of individual steps in the analytical procedure, the use of standard reference materials, and quality control procedures with real samples and actual results. (auth)

15229 (IAEA-157, pp 191-204) SUMMARY REPORT AND RECOMMENDATIONS. 1973.

From research coordination meeting; Vienna, Austria (19 Feb 1973).

Recommendations are presented for the standardization of procedures used in the analysis of trace elements (by activation methods or otherwise) in relation to cardiovascular diseases. It is suggested that quality control can be implemented by the use of analytical reference materials. The conclusions drawn on the basis of the papers presented are briefly summarized. (ERB)

15230 (INIS-mf-717) DETERMINING CERTAIN MACRO- AND MICROELEMENTS IN SOILS WITH THE AID OF NEUTRON ACTIVATION ANALYSIS. Najdenov, M.; Rajkov, L.; Nikolaev, A.; Apostolov, D. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 9p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Neutron activation analysis was applied for determining the total content of certain macro- and microelements in soils. By means of irradiation in the reactor of the Research Institute of Physics of preliminarily prepared standards and soil samples and after gamma spectrometry the content in the soils of the following elements is determined: Ti, Mg, V, Al, Ca, Mn, and Na. Data from neutron activation analysis are compared with data obtained with the aid of the total chemical analysis of the same elements and in most cases the data from the two methods coincide. (auth)

15231 (INIS-mf-766-4, pp 213-244) DETERMINATION OF U, Th, AND OTHER ELEMENTS IN GEOLOGICAL SAMPLES BY NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS. Moucka, V.; Kucera, J. (Geologicky Pruzkum Uranoveho Prumyslu, Pribram, Czech.). [nd]. (In Czech).

Possibilities of nondestructive analysis of mineralogical samples are considered in view of the determination of uranium and thorium contents. INAA is characterized by an extremely high sensitivity for the determination of many trace and rare elements; 20 to 30 elements can be determined simultaneously when using a gamma spectrometer with a semiconductor detector having high resolving power. When irradiating a sample with thermal neutrons, the high sensitivity and selectivity of INAA can be made use of for the determination of very low concentrations of trace and rare elements or for an analysis of very small sample amounts. Basic terms and principles involved in INAA are explained; the questions of the sensitivity and selectivity of determination are discussed. The possibilities of determining ~25 elements are surveyed. The particularities and limitations of analyzing samples with a higher uranium content are discussed. A possible INAA application in mineralogical and geochemical investigation is outlined. (auth)

15232 (LA-UR-73-1615) DETECTION OF THE STABLE ISOTOPES OF CARBON USING A 3-MV VAN DE GRAAFF AND THE APPLICATION TO ENVIRONMENTAL AND BIOLOGICAL STUDIES.

Close, D. A.; Malanify, J. J.; Umbarger, C. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 5p. (CONF-731112-14). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

The proton radiative capture reactions, $^{12}C(p,\gamma)^{13}N$ and $^{13}C(p,\gamma)^{14}N$, have been studied to determine their applicability for assaying materials for their ^{13}C enrichment. This technique for determining carbon isotopic ratios compares favorably with the more classical analysis techniques for ^{13}C tracer experiments. (auth)

15233 (N-73-24709) EVALUATION OF RADIOISOTOPE TRACER AND ACTIVATION ANALYSIS TECHNIQUES FOR CONTAMINATION MONITORING IN SPACE ENVIRONMENT SIMULATION CHAMBERS. Final Report. Smathers, J. B.; Kuykendall, W. E. Jr.; Wright, R. E. Jr.; Marshall, J. R. (Texas Agricultural and Mechanical Univ., College Station (USA). Engineering Experiment Station). 1 Apr 1973. Contract NAS9-12586. 108p. (NASA-CR-128931). NTIS $7.50.

Radioisotope measurement techniques and neutron activation analysis were evaluated for use in identifying and locating contamination sources in space environment simulation chambers. The alpha range method allows the determination of total contaminant concentration in vapor state and condensate state. A ^{252}Cf neutron activation analysis system for detecting oils and greases tagged with stable elements is described. While neutron activation analysis of tagged contaminants offers specificity, an on-site system is extremely costly to implement and provides only marginal detection sensitivity under even the most favorable conditions. (auth)

15234 (RISO-271) SIMULTANEOUS DETERMINATION OF ARSENIC, MANGANESE, AND SELENIUM IN HUMAN SERUM BY NEUTRON ACTIVATION ANALYSIS. Damsgaard, E.; Heydorn, K.; Larsen, N. A.; Nielsen, B. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jun 1973. 35p. (CONF-710623-3). Dep. NTIS (U. S. Sales Only) $3.75.

From 2nd conference on the recent developments in neutron activation analysis; Cambridge, UK (28 Jun 1971).

A procedure for the simultaneous determination of arsenic, manganese, and selenium in human serum is described, and its performance characteristics are evaluated with particular reference to manganese. Blank values depend critically on irradiation containers, and only one type of polyethylene ampoule gave a sufficiently low limit of detection. Other suspected sources of random and systematic errors are investigated; they did not, however, jeopardize precision or accuracy of analytical results. Careful studies of the sampling techniques with actual as well as simulated serum revealed considerable contamination with arsenic and manganese under normal hospital conditions; in addition, loss of added dimethylselenide was observed even during deep-freeze storage of serum. A detailed sampling procedure with special precautions against contamination is described and is shown to yield meaningful results for normal, human serum. Results tend to agree with the lowest values reported in the literature, and the analytical precision is sufficient for determination of the standard deviation of the distribution of all three elements in human serum. (auth)

15235 PREVENTION OF MERCURY LOSS FROM PLASTIC IRRADIATION CONTAINERS. McFarland, R. C. (Georgia Inst. of Tech., Atlanta). Radiochem. Radioanal. Lett.; 16: No. 1, 47-51(31 Dec 1973).

The loss of inorganic mercury from plastic irradiation containers can be minimized by the addition of certain strong acids or oxidizing agents prior to irradiation. Therefore the standard quartz encapsulation can be replaced by the less expensive polyethylene encapsulation without loss of reliability. (auth)

15236 RAPID AND SENSITIVE NEUTRON ACTIVATION METHOD FOR URANIUM IN WATER. Steinnes, E. (Institute for Atomic Energy, Kjeller, Norway). Radiochem. Radioanal. Lett.; 16: No. 1, 25-29(31 Dec 1973).

A simple neutron activation method based on 23.5-min ^{239}U using solvent extraction with tri-n-butyl phosphate as a selective separation step is described. The method is sufficiently sensitive and precise for the determination of uranium in natural freshwater samples. The separation time for 2 samples is 10 min, and no chemical yield determination is necessary. (auth)

15237 SEPARATION OF FLUORINE-18 AND FLUORINE-17 IN SODIUM. Nordmann, F.; Engelmann, C. (CEN de Saclay, Gif-sur-Yvette, France). Radiochem. Radioanal. Lett.; 16: No. 1, 17-24(31 Dec 1973). (In French).

A chemical method of ^{18}F separation in sodium is described. It takes 55 min and a 10^{10} decontamination factor for the cations Na^+ and Cu^{2+} was obtained. A fast 17-chemical separation method is also reported. It is less efficient than the above but enables this latter radioisotope to be isolated in 3 min. These methods are used in the determination of oxygen in sodium by activation methods. (auth)

15238 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS IN THE DETERMINATION OF THE $^{235}U/^{238}U$ ISOTOPIC RATIOS FOR SAMPLES FROM 0.4 TO 93% ^{235}U. Lu, W. D. (Inst. of Nuclear Energy Research, Taipei, Taiwan). (1973). vp.

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

A simple neutron activation method for the determination of the $^{235}U/^{238}U$ isotopic ratios using a high-resolution Ge(Li) detector for gamma detection is reported. The $^{235}U/^{238}U$ ratios are determined from the activity ratios of $^{143}Ce/^{239}Np$. The 293- and 278-keV gamma rays from ^{143}Ce and ^{239}Np, respectively, were chosen for their activity measurements. With well thermalized neutrons the isotopic ratios can be determined for samples with ^{235}U contents from 0.4 to about 30%. The accuracy is about 2 to 3% for samples with ^{235}U contents below about 10%. With increasing ^{235}U contents the accuracy decreases because the relative intensity of the 278-keV gamma ray of ^{239}Np becomes too weak to be determined accurately. For samples of high ^{235}U content, epithermal neutrons must be used in the activation to enhance the relative production rate of ^{239}Np with respect to that of fission products. The epithermal neutrons are obtained by means of cadmium filters. With samples well shielded by cadmium filters, i.e. inside a closed cadmium case, the enhancement of the relative production rate of ^{239}Np to that of ^{143}Ce is found to be about 80 fold compared with the activation of well thermalized neutrons. (GE)

15239 STATISTICAL EVALUATION OF TWO AIR SAMPLERS AND OF THE ACTIVATION ANALYSIS OF AEROSOLS. Heindryckx, R.; Dams, R. (State Univ., Ghent). Bull. Soc. Chim. Belg.; 82: No. 9-10, 611-615(1973).

Using two types of high volume air sampling systems the reproducibility of the sampling procedure, the homogeneity of the collected aerosols over the filter, and the standard deviation of the analyses are evaluated. Aerosols are collected simultaneously with four identical samplers on one location. The four filters are quartered and the concentrations of 11 elements are determined in triplicate on all 16 quarters by instrumental neutron activation analysis. A variance and a propagation of errors analysis are performed. (auth)

15240 TRACE ELEMENTS IN ATMOSPHERIC AEROSOL IN THE HEIDELBERG AREA, MEASURED BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Bogen, J. (Univ., Heidelberg). Atmos. Environ.; 7: No. 11, 1117-1125(Nov 1973).

The concentrations of 18 trace elements (Cl, La, Na, Co, In, Fe, Sc, Mn, Cs, Br, Ag, Sb, Cd, Cr, Hg, Sn, Ce, Sm) in atmospheric aerosol are measured by neutron activation and γ-ray spectrometry using Ge(Li)-detectors. Trace element concentrations of different filter materials used for aerosol deposition are determined. The trace element concentrations measured in Heidelberg are reported for the measuring period (April to June, 1971) and the average values are compared to values given in the literature for Paris, East Chicago, and Niles (U.S.A.). Considering the concentrations of the different elements in the aerosol relative to the concentration of sodium, three groups of elements are of interest which are related to the ocean (Na and Cl), the earth crust (La, Fe, Sc, Mn, Cr, Ce, Sm), and to anthropogenous production (Cd, Ag, Sn, Sb, Hg, Co, Br) as the main sources. (auth)

15241 METHOD FOR AUTOMATIC ANALYSIS OF GAMMA-RAY SPECTRA AND ITS APPLICATION TO ACTIVATION ANALYSIS. 4. Takeuchi, T. (Kyoto Univ.). Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 6: 68-73(Sep 1973).

15242 APPLICATION OF THERMAL NEUTRON ACTIVATION FOR AUTORADIOGRAPHIC DETECTION OF FINGERPRINTS. Isono, H.; Kozuka, H. (National Research Inst. of Police Science, Tokyo). Radioisotopes (Tokyo); 22: No. 10, 575-578(Oct 1973).

15243 HEAVY-ELEMENT DIFFUSION IN CADMIUM TELLURIDE. Hage-Ali, M.; Mitchell, I. V.; Grob, J. J.; Siffert, P. (Univ., Louis Pasteur, Strasbourg). Thin Solid Films; 19: No. 2, 409-418(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The diffusion behavior near the surface for gold and bismuth in cadmium telluride was investigated by the charged particle Rutherford back-scattering and ion microprobe analysis techniques in the temperature range 200 to 450°C. For all temperatures above 370°C penetration saturation effects are observed. Preliminary results for the activation energy (1.7 eV for gold, 0.3 to 0.4 eV for bismuth) and diffusion constants D_0 are presented. For comparable temperatures, a much more rapid diffusion of gold occurs in evaporated layers of cadmium telluride than in the crystalline case. It further appears that for near-surface diffusion (<1000 Å) the

back-scattering technique is more useful, with its higher resolution and its ability to give information on atom location, than the ion microprobe. However, the latter technique shows advantages when information from greater depths is required. (auth)

15244 LINE-SHAPE EXTRACTION ANALYSIS OF SILICON OXIDE LAYERS ON SILICON BY CHANNELING-EFFECT MEASUREMENTS. Chu, W. K. (California Inst. of Tech., Pasadena); Lugujjo, E.; Mayer, J. W.; Sigmon, T. W. Thin Solid Films; 19: No. 2, 329-337(19 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

A technique of line-shape extraction was developed and applied to find the number of Si atoms and O atoms/cm^2 of anodically grown and thermally oxidized silicon oxide layers. Backscattering and channelling effect measurements with 0.3 to 2.0 MeV $^4He^+$ ions were used. The thicknesses of the silicon oxide investigated ranged from native oxide thickness to 1500 Å. For all thicknesses the composition was found to be silicon-rich, with the number of Si atoms/cm^2 equal to one-half the number of oxygen atoms/cm^2 plus $(0.8-1) \times 10^{16}$ Si/cm^2. It is proposed that the oxide layer is stoichiometric SiO_2 with a silicon-rich transition region between the oxide layer and the crystal substrate. The presence of such a transition region at the interface should be considered when evaluating the composition of dielectric layers on semiconductors. (auth)

15245 ELEMENTAL ANALYSIS BY DIFFERENTIATED BACKSCATTERING SPECTROMETRY. Peisach, M. (Southern Universities Nuclear Inst., Faure, South Africa). Thin Solid Films; 19: No. 2, 297-312(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

With thick targets, improved definition of spectral energies and improved precision in determining elemental surface concentrations have resulted from the use of arithmetic differentiation of the spectra. A large number of pure compounds in pellet form were bombarded with beams of protons and $^4He^+$ ions up to about 4 MeV, and singly charged $^{14}N^+$ beams up to 1.6 MeV. Spectra were measured with surface barrier detectors and analyzed by a programme which first smoothed the data before differentiation. The method was tested on thin films, glass films of intermediate thickness, layers of powdered ore deposited on carbon foils and thick geological samples. (auth)

15246 BACKSCATTERING STUDY OF HEAVY-ION DISTRIBUTION IN SEMICONDUCTORS. Furukawa, S.; Matsumura, H.; Ishiwara, H. (Tokyo Inst. of Tech.). Thin Solid Films; 19: No. 2, 399-406(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The three-dimensional distribution of ^{84}Kr ions implanted into a Si substrate with 180 keV energy to a dose of 2×10^{16} ions/cm^2 was measured by a backscattering technique with 1.5 MeV $^4He^+$. The distribution was observed as a distorted curve due to the influence of the ^{84}Kr ions on the specific energy loss of the $^4He^+$. By considering the correction of the distortion, it is shown that the experimental results are in good agreement with theoretical predictions, and it is concluded that in quantitative discussions on the profile of impurity atoms in heavily doped material the influence of the impurity atoms on the specific energy loss cannot be neglected. (auth)

15247 USE OF FOCUSED ION BEAMS FOR ANALYSIS. Cookson, J. A.; Pilling, F. D. (Atomic Energy Research Establishment, Harwell, Eng.). Thin Solid Films; 19: No. 2, 381-385 (17 Dec 1973).

From international conference on ion beam surface layer analsis; Yorktown Heights, NY (18 Jun 1973).

A system of quadrupole lenses was provided for Harwell's 3 MeV IBIS accelerator, giving focused beams of protons, deuterons or α-particles down to a spot size of 4 μm diameter. The beam current depends on the spot size but the current density even down to the smallest spot size is about 26 μA mm^{-2}, i.e., 0.33 nA at 4 μm diameter. Analysis performed with the system has involved the detection of: (a) x-rays from proton bombardment; (b) protons from (d,p) reactions on carbon in steel; (c) γ-rays from the $^{16}O(d,p)$ reaction; and (d) backscattered protons and α-particles Examples of the last two techniques are given. (auth)

15248 ^{16}O CONTAMINATION IN ^4He ANALYSIS BEAMS. Picraux, S. T.; Borders, J. A.; Langley, R. A. (Sandia Labs., Albuquerque, NM). Thin Solid Films; 19: No. 2, 371-380(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The $^4He^+$ beam from a Van de Graaff accelerator is often accompanied by an $^{16}O^+$ beam of the same energy. If, after acceleration and before magnetic analysis, one electron is stripped from the oxygen ion to form $^{16}O^{2+}$, these ions will not be separated from $^4He^+$ during magnetic analysis. The $^{16}O^{2+}$ fraction in the $^4He^+$ beam was measured by analyzing back-scattering spectra for a thin Au film and the O to He ion charge ratio of 2 : 1 was confirmed by electrostatic deflection. Ion source conditions and the pressure in the beam lines strongly affect the $^{16}O^{2+}$ fraction and the dependence of the O^{2+}/O^+ ratio on pressure is found to be in approximate agreement with predicted values. A formula for estimating the $^{16}O^{2+}$ beam intensity, based on charge exchange data and measurement of the primary $^{16}O^+$ beam intensity, is $N[O^{2+}] = 13$ P(torr) l(cm) $N[O^+]$, where P is the total gas pressure, l the length of the beam line between the accelerator and switching magnet and $N[O^{2+}]$ and $N[O^+]$ are the beam intensities of the respective species. The $^{16}O^{2+}$ contamination of $^4He^+$ beams is easily removed by electrostatic separation. (auth)

15249 NEUTRON ACTIVATION ANALYSIS OF STABLE HEAVY METALS AS MULTIPLE MARKERS IN NUTRITIONAL MONITORING. Gray, D. H.; Vogt, J. R. (Univ. of Missouri, Columbia). J. Agr. Food Chem.; 22: No. 1, 144-146(1974).

A method is reported by which instrumental neutron activation analysis of various heavy metal elements has been applied to the monitoring of nutrient intake of laboratory animals. Some data are presented illustrating reproducibility. The scope of the method may be expanded by utilization of more or different markers. Tables are included, listing elements which may be useful as nutritional markers. It is hoped that ultimately this system may be applied to studies involving man. (auth)

15250 INSTRUMENTAL NEUTRON-ACTIVATION ANALYSIS OF ORES AND ROCK-FORMING MINERALS USING Ge(Li) SEMICONDUCTOR DETECTORS AND COMPUTERS. Lobanov, E. M.; Levushkii, Yu. A.; Vlasyuga, S. P. (Inst. of Solid State Physics and Semiconductors, Minsk). Dokl. Akad. Nauk BSSR; 17: No. 10, 905-908(Oct 1973). (In Russian).

A nondestructive neutron activation method described for determining as many as 24 elements (Sc, Cr, Fe, Co, Zn, Rb, Sr, Zr, Sb, Cs, Ba, La, Ce, Nd, Sm, Eu, Gd, Tb, Tm, Yb, Lu, Hf, Ta, Th) in ores and rock-forming minerals uses coaxial Ge(Li) semiconductor detectors of 8.5 to 50.5 cm^3 volume. A 500-g sample, ground to 200 mesh, was irradiated at 1.8×10^{13} n/cm^2 · sec for 10 hr and cooled 8 to 12 days. Because of the complexity of the spectra, they were processed on an EVM M-220 gamma spectrometer using a specially designed calculation program. The processing time required was 5 to 10 min for 15 to 25 elements. The precision was 8 to 18%. (TTT)

15251 MERCURY IN FOODSTUFFS. Studies on Total Daily Diets. Schelenz, R.; Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 153: No. 3, 151-154(Nov 1973). (In German).

The mercury content of the complete daily rations of 4 adult males were determined over a period of one week each by means of neutron activation analysis. Weekly intake (with beverages) was 57, 70, 21, and 192 μg, respectively. Compared to the other three individuals, the last one had consumed considerably more fish and more mushrooms, these being foodstuffs with a relatively high mercury concentration. Even this person did not exceed the acceptable weekly intake of 300 μg of total Hg, as recommended by WHO/FAO. Together with other evidence, these results strengthen the impression that no mercury problem exists with respect to nutrition in the Federal Republic of Germany. (GE)

15252 DETERMINATION OF METALLIC IMPURITIES IN KNK PRIMARY SODIUM BY NEUTRON ACTIVATION ANALYSIS. Stamm, H. H.; Clauss, H.; Nolte, K. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Anal. Chem.; 266: No. 5, 337-340(1973). (In German).

Iron, Cr, Co, Sb, Zn, Ag, and Hg were determined in KNK primary sodium by means of FR2 neutron activation analysis. Zn (3.7 ppM), Ag (0.1 ppM), and Hg (0.02 ppM) had a rather homogeneous distribution, while Fe, Cr, Co, and Sb varied considerably from one sample to another. The activities of Cr-51, Fe-59, Co-60, Zn-65, Ag-110m, Sb-122, Sb-124, and Hg-203 in KNK primary sodium after 100 and after 200 days of full power operation were calculated from the values of impurity concentrations in nine irradiated samples. The specific activity of Na-22 will achieve equilibrium conditions after <1 month of operation at a level of about 50 nCi/g sodium. (auth)

15253 KEEPIN'S METHOD APPLIED TO SEPARATE DETERMINATION OF FISSILE ELEMENTS IN MIXTURES USING A BEAM OF GAMMA QUANTA. Dorosh, M. M.; Kovlenko, N. I.; Parlag, A. M.; Shkoda-Ul'yanov, V. A. At. Energ. (USSR); 35: No. 1, 59-61(Jul 1973). (In Russian).

Yield and depletion curves are presented for the photofission of ^{233}Th, ^{235}U, ^{236}U and ^{239}Pu with gamma quanta having a maximum energy of 15 MeV, and also for the photofission of ^{235}U and ^{238}U with gamma quanta having energies of 8 and 10 MeV. Discrimination ratios are given for characterizing ^{235}U in the presence of ^{238}U. The discrimination ratios seem to be favorable for the analysis of fissionable elements, but require experimental confirmation. (8JR)

15254 ACTIVATION ANALYSIS WITH HIGH-ENERGY PROJECTILES. Accuracy in Calculating the Detection Limit. Jaeger, U.; Muenzel, H. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Anal. Chem.; 267: No. 2, 96-99(Oct 1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Ger. (2 Apr 1973).

Investigations, limited to the type of (i,xn) reactions, have shown that in practically all cases the detection limit can be determined with sufficient accuracy to a factor of two using either the experimentally determined excitation functions or the excitation functions estimated by systematics. (auth)

15255 DETERMINATION OF PLATINUM IN BORON-CONTAINING GLASSES BY NEUTRON ACTIVATION ANALYSIS. Menke, H.; Weber, M. (Univ., Mainz). Z. Anal. Chem.; 267: No. 2, 122-126(Oct 1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Ger. (2 Apr 1973).

Neutron activation analysis is the only analytical method that allows the determination of platinum in the concentration range below 1 ppM. Because of the high activity of the matrix the determination was done via the daughter product of 31 min ^{199}Pt, ^{199}Au which, due to its half-life of 3.15 d, can be chemically separated. A procedure for acid decomposition of the glass and chemical separation of the gold was worked out that can be performed within a reasonable time. As the boron content of many glasses causes a high neutron self-shielding, the self-shielding effect as a function of the matrix and the boron concentration was investigated. A procedure to reduce the self-shielding effect was also developed. Using the procedure described, platinum concentrations down to 0.1 ppM could be determined. (auth)

15256 NUCLEAR DATA AND NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL SAMPLES. Spyrou, N. M. (Univ. of Surrey, Guildford, Eng.). pp 335-349 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

The application of activation analysis in the life sciences, environmental studies, and industry has increased to such an extent that the technique has been introduced to undergraduates at this University in the form of short-term inter-disciplinary projects. Further it is predicted that the growth area of routine application will be in the biomedical field and therefore activation analysis is included in certain postgraduate courses (e.g., Clinical Biochemistry, Radiation Studies, and Medical Physics). However, this has highlighted several problems that arise mainly from the short period of time available for training in the technique and the multidisciplinary background of the students. It is suggested that part of the solution lies in a more suitable presentation of nuclear data, which will enable the untrained analyst to reach a quick decision as to the procedure he is to follow for the determination of the required elements in a sample. An illustration is given in which nuclear data are used with particular reference to the analysis of biological material. Comments are included on the specific areas where uncertainties exist or greater accuracy is required in nuclear data. This paper therefore attempts, by looking to the future, where, for example, in a hospital department routine analyses are undertaken, to provide an approach which will facilitate use of the technique by those who are not radiation scientists. (auth)

15257 MODERN TRENDS IN ACTIVATION ANALYSIS. Albert, P. (CNRS, Saclay, France). pp 189-192 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

Two meetings held at Saclay in October 1972 are discussed: the Fourth International Conference on Modern Trends in Activation Analysis and the International Colloquium of the CNRS on the Activation Analysis of Microquantities of Elements. A brief survey is given of the topics discussed and the trends resulting from the meetings. (auth)

15258 NUCLEAR DATA FOR ACTIVATION ANALYSIS. Requirements and Present State of Compilations. Krivan, V. (Max-Planck-Institut fuer Metallforschung, Schwaebisch Gmuend, Ger.). pp 193-225 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 Vol. 2); CONF-730302-(Vol. 2).

A survey of the need of nuclear data in solving individual activation-analytical problems is given. Criteria such as sensitivity, accuracy, feasibility of nondestructive analysis and simultaneous determination of several elements permitting the choice of an optimum activation technique and experimental parameters are discussed and related to the relevant nuclear data. The importance of nuclear data in the practical application of activation analysis for both the absolute and the comparative method as well as for the identification of radionuclides and in analytical γ spectrometry is also discussed. A critical picture is presented of the existing compilations and handbooks with regard to completeness, accuracy, and presentation of the nuclear data contained therein. Activation with thermal, epithermal and fast neutrons, photons and charged particles is considered in detail. In addition, prompt-radiation activation analysis and analysis based on the elastic scattering of heavy charged particles are included. (auth)

15259 NUCLEAR DATA BASES FOR ACTIVATION ANALYSES. Bewers, J. M. (Bedford Inst. of Oceanography, Dartmouth, Nova Scotia); Pearson, G. J.; Merritt, W. F. pp 229-240 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

Several existing nuclear data compilations are surveyed and their applicability to activation analysis are discussed. These compilations generally fall into two categories: those dealing solely with neutron activation data, both for instrumental and radiochemical purposes, and those providing more general data for a wide range of nuclear activation mechanisms. The former type is mainly restricted to a single application while, to date, the latter type is only useful for reference purposes. Two approaches to data reduction in instrumental activation analysis are currently employed. The first method utilizes a library of standard spectra which are unique to the particular irradiation and counting facilities used. In contrast, the second approach uses a library of basic nuclear parameters together with a mono-standard flux determination. Experience with an existing data base of this latter type for the semi-automatic analysis of environmental samples has revealed some deficiencies in contemporary nuclear information. These predominate in the areas of absolute gamma-ray intensities and particle capture cross-sections. Extensive use of this system has revealed other requirements not directly related to the reliability of the available nuclear data. To meet these requirements for quality control purposes, it was possible to generate different hard-copy subsets of the data file, notably photon energy and isotope-ordered listings and a compilation of gamma-ray interferences. There is also an obvious need for more technical information regarding reactor characteristics (e.g., neutron energy profiles and flux gradients). A list of parameters for charged-particle, photon, slow-neutron and fast-neutron activation analysis is discussed in relation to the establishment of an international master data base. (auth)

15260 RESONANCE INTEGRALS APPLIED TO THE MULTIPLE-COMPARATOR METHOD IN REACTOR NEUTRON ACTIVATION ANALYSIS. Van der Linden, R.; De Corte, F.; Hoste, J. (Univ., Ghent). pp 241-263 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

Classical reactor neutron activation analysis requires preparation, irradiation, and counting of a standard for each element to be determined. This method is time-consuming, especially for routine multi-element analysis, and may be a cause of errors, mainly due to flux gradients in the irradiation capsule. Moreover, unexpected elements, for which no standards are co-irradiated, cannot be determined. These disadvantages can be avoided by applying a multiple comparator method. In this technique, the specific activities of the standards are derived from, at least, two comparator isotopes irradiated together with the sample. If the ratios of the specific activities of the isotopes investigated to the specific activities of the comparator isotopes (k-values) are experimentally determined in a well-defined standard reactor site, they can be converted for each new irradiation position. As the isotopic activity

induced by reactor neutron irradiation is an additive function for thermal and epithermal activation, the conversion of the k-values should take into account the thermal and the epithermal activation parameters, not only of the reactor neutron spectrum, but also of the isotopes. As far as the former is concerned, it can be proved mathematically that the knowledge of the ratios of thermal to epithermal neutron fluxes (ϕ_{th}/ϕ_{epi}) for the standard and the unknown irradiation position is sufficient for the conversion of the k-values. As to the isotopic parameters, it can be shown that only the ratios of the infinite dilution resonance integrals to the thermal activation cross-sections (I_0/σ_{th}) are needed for the isotopes determined and for the comparator isotopes. Thus it can be stated that the multiple-comparator method requires: (a) experimental determination of the k-values under well-defined irradiation and counting conditions. These ratios can be evaluated afterwards, thus offering the possibility of determining unexpected elements; (b) knowledge of the flux ratios for the irradiation positions. These ratios can be calculated from the activities of, at least, two irradiated comparator isotopes, using a relative activity measurement method; (c) knowledge of accurate I_0/σ_{th}-values. Because of the lack of well-known I_0-values for many isotopes, the I_0/σ_{th}-values were determined for all γ-emitting nuclides useful in reaction neutron activation analysis. The measurements were carried out according to the Høgdahl flux convention. The values were determined in different reactor neutron spectra. In some cases, an experimental study was made to avoid self-shielding. Errors are estimated to be lower than 5%. A study of the error multiplication, when applying the multiple-comparator method, was performed. The method was analyzed stepwise, and the change of the initial error caused by irradiating and measuring the isotopes is described as a function of the mathematical operations. A general expression is derived for the overall error on the final analytical result. This study of error multiplication is especially important in giving a mathematical solution for the choice of comparator isotopes and irradiation conditions for each individual analytical problem. (auth)

15261 NUCLEAR DATA OF IMPORTANCE IN EPITHERMAL NEUTRON ACTIVATION ANALYSIS. Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). pp 265-270 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

The use of a suitable filter material such as cadmium to facilitate selective activation with epithermal neutrons is of interest in many cases in reactor activation analysis. This enables considerable suppression of interfering activities, provided that the ratio resonance activation integral/thermal neutron activation cross-section of the target nuclide giving rise to the interfering activity is low compared to that upon which the analysis is based. This technique is primarily of interest for improving precision and sensitivity in purely instrumental activation analysis, but in some cases may also be applied to minimizing fission-product interference, or, simply, to a reduction of the matrix activity to an acceptable level in cases where major elements in the sample have high activation cross-sections. To permit estimation of the possible advantage of introducing epithermal activation in a specific case, it is necessary to know the values of thermal and epithermal activation cross-sections of the nuclides involved. Moreover, it is useful to know the energies of the main resonances contributing to the activation integral, in order to ascertain that the filter used does not interfere significantly with the resonance activation. In some cases, it may be desirable to calculate the extent of resonance neutron shielding in the sample, in which case the knowledge of resonance parameters such as partial widths for neutron and gamma emission is important. Unfortunately, in many cases the necessary data are not available from the literature, which is particularly the case for target nuclides with low isotopic abundances. In the present paper, the importance of various types of nuclear data in resonance neutron activation analysis and the availability of such data in the literature are discussed. (auth)

15262 NEUTRON-FLUX SPATIAL DISTRIBUTION AND NUCLEAR CONSTANTS: APPLICATION TO ACTIVATION ANALYSIS. Vorsatz, B.; Zemplen-Papp, E.; Kelen, E. (Institut Central de Recherches Physiques, Budapest). pp 295-300 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

Separating the interfering activities produced by neutron generator activation is in any case a complicated task, especially when this cannot be done by gamma spectroscopy. The neutron generator itself produces neutrons by a nuclear reaction; several reactions are used for this purpose, but most often the $^3T(d,n)^4He$ nuclear reaction is used. The products of this nuclear reaction are alpha particles, which are absorbed in the parts of the neutron generator, and "fast neutrons" of 14.7-MeV energy, which leave the generator and therefore can be utilized for activation. For a given irradiation system, neutrons are produced with different energy, depending on the effect of the surroundings. For a given activation reaction, the spatial energy distribution of the irradiating neutrons, as well as the energy dependence of the activation cross-section of the produced nuclear reaction, therefore, provide a means of distinguishing the activities according to their origin. This principle can be utilized for simultaneous and nondestructive determination of silicon and aluminium contents, and thus has particular significance in the analysis of mineral samples. An example for the application of the method is given. (auth)

15263 NUCLEAR DATA FOR BREMSSTRAHLUNG ACTIVATION ANALYSIS OF VALUABLE TRACE ELEMENTS IN THE COPPER ORE. Ratynski, W.; Stegner, A.; Sujkowski, Z. (Inst. of Nuclear Research, Swierk, Poland). pp 411-429 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

Bremsstrahlung activation analysis with the help of a betatron has recently been applied successfully to continuously controlling the copper-ore mining process. The possibility of applying the same method to the analysis of valuable elements contained in waste material left after copper processing is discussed. The available nuclear data relevant to the analysis are collected. A user-oriented form of presentation of these data is proposed. Further data needs are pointed out. The data presented concern the elements sought as well as those elements that contribute to the background. Detailed data analysis is given for the elements Mo, Ti, and Rh. Some auxiliary yield measurements have been carried out and the results are presented in tabular and graphical form. Complementary methods of activation and fluorescence analysis are discussed in connection with the copper-mine or copper-works waste material problem. (auth)

15264 IMPORTANCE AND ROLE OF NUCLEAR DATA IN ACTIVATION ANALYSIS USING CHARGED PARTICLES OR PHOTONS. Engelmann, C. (CEN, Saclay, France). pp 459-473 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2.); CONF-730302-(Vol. 2).

The importance and the role of nuclear data in activation analysis using charged particles or photons are discussed; after a general survey of activation analysis, different standardization methods are presented, the influence of competitive nuclear reactions is discussed and the importance of compilations of certain nuclear data and of special compilations directly aimed at activation analysis is shown. (auth)

15265 NUCLEAR REACTIONS INDUCED BY FAST PARTICLES. Accuracy of the Calculated Activities. Jaeger, U.; Muenzel, H. (Inst. for Radiochemistry, Karlsruhe, Ger.). pp 475-482 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

Many applications and calculations in activation analysis use the excitation functions for the nuclear reactions published in the literature or obtained from the systematics. In general, it is very difficult to judge the accuracy of the individual value obtained in such calculations. Therefore, an estimation was made of the accuracy that can be expected. This was done by calculating the activity produced in thick targets using the excitation functions for a given nuclear reaction published by different authors. The results are discussed with regard to the errors of excitation functions stated in the publications. In those cases where no experimental excitation functions are available one has to resort to the estimated values based on the systematics. To gain an impression of the errors expected for the activities obtained with the aid of such values several calculations were made and compared with available experimental data. These calculations were done for nuclear reactions induced by charged particles and fast neutrons. (auth)

15266 NEED FOR NUCLEAR DATA IN ACTIVATION ANALYSIS USING CHARGED PARTICLES OF INTERMEDIATE ENERGY. Debrun, J. L.; Barrandon, J. N.; Albert, P. (CEN, Saclay,

France). pp 483-487 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

After a brief survey of the research work done by the group dealing with the application of nuclear reactions to chemical analysis (Saclay), the nuclear data needed in activation analysis using charged particles of intermediate energy is indicated. Often these data are not sufficient and sometimes even missing, and there is a real need for both experimental work and data compilation and evaluation in this field of research. (auth)

15267 PROPOSED METHOD FOR ASSAYING SULPHUR BY PROTON ACTIVATION ANALYSIS USING A LOW-ENERGY ACCELERATOR. Eswaran, M. A.; Ragoowansi, N. L.; Ismail, M. (Bhabha Atomic Research Centre, Trombay, India). pp 489-494 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

A method of proton activation analysis is proposed for assaying sulfur using the capture reaction $^{32}S(p,\gamma)^{33}Cl$. The method involves short irradiations of a few seconds by a mechanically chopped beam from a low-energy Van-de-Graaff accelerator, coupled with the measurement of the residual positron activity of $T_{\frac{1}{2}} = 2.52$ s, resulting from the decay of ^{33}Cl. A plastic scintillation detector was used for positron counting in conjunction with a multi-channel analyzer operated in the multi-scaling mode with a dwell time of 40 ms per channel. The time for irradiation was 4 s and for counting was 10 s. The repeated irradiation-counting sequence was automatically controlled by a timer-relay unit which effects mechanical chopping of the beam. This activation reaction features a high-abundance target isotope (95%), and the method is highly selective since only the counts showing the correct half-life are included for the analysis. This proposal is based on the detailed study [Phys. Rev. C5 (1972) 1270] of the excitation function for this reaction in the bombarding-energy range 3.3 to 5.4 MeV, applying this technique and using the model C-N Van-de-Graaff Accelerator at Trombay. A sensitivity of a few $\mu g/cm^2$ can be achieved by this method which is rapid and uses only a low-energy accelerator. This method can be fruitfully used in assaying sulfur in different materials (e.g., in petroleum products). (auth)

15268 SIGNIFICANCE OF STOPPING POWERS IN EVALUATING AND USING CHARGED-PARTICLE EXPERIMENTS. Mitchell, I. V.; Winterbon, K. B.; Brown, F. (Chalk River Nuclear Labs., Ont.). pp 498-506 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

Charged-particle analysis, including nuclear reactions, Rutherford scattering and atomic processes such as x-ray emission, is now widely used for analytical purposes. Such analyses are frequently difficult because the stopping powers of charged particles must be used to interpret them correctly. A well-known example is the problem of calculating thick-target yields. In the case of a sample of uniform composition, the analyst can frequently avoid the problem by using a properly chosen comparative standard. For samples in which the depth distribution of the impurity is not known the problem may require a more sophisticated approach. Similar situations arise when charged-particle analysis is used to determine the depth profile of an impurity or to measure the stoichiometry of a compound. The importance of stopping powers in measuring nuclear life-times by Doppler-shift techniques has also been recognized. The difficulties in obtaining good stopping power data that are really applicable to the particular system being investigated are emphasized; especially in work involving single crystals where the phenomena of ion channelling or blocking can play a dominant role. There is also the related question of whether the data themselves contain errors because they came from an experiment that required stopping power data for its interpretation; a simple example is determining a target thickness from energy loss measurements. Another problem comes from the fact that nuclear data usually come from experiments in nuclear physics which have a purpose quite unconnected with analysis; for example, experiments on the relative abundance of γ rays rather than their absolute intensities. Finally, there is the question of how the compiler might simplify the problems of the user. Data might be presented in more useful or extensive forms. A central authority for collecting, revising, and distributing stopping-power data would be most useful. Suitable experimental procedures could be suggested since although the problems might be well recognized by a nuclear physicist they may not be obvious to users in other disciplines. Another approach would be to provide, or list, computer programs that would enable the user to apply the data to his particular problem. (auth)

15269 DETERMINATION OF TRACE ELEMENTS IN COAL, FLY ASH, FUEL OIL, AND GASOLINE: A PRELIMINARY COMPARISON OF SELECTED ANALYTICAL TECHNIQUES. von Lehmden, D. J.; Jungers, R. H.; Lee, R. E. Jr. (National Environmental Research Center, Research Triangle Park, NC). Anal. Chem.; 46: No. 2, 239-245(Feb 1974).

The Environmental Protection Agency has initiated a program to monitor trace elements in fuels and related emissions to the atmosphere. As part of this program, nine laboratories using similar analytical methods were asked to determine the concentration of 28 elements in the same fuel and fly ash matrices. Among the elements investigated were mercury, beryllium, lead, cadmium, arsenic, vanadium, manganese, chromium, and fluorine. The analytical methods used included neutron activation analysis, atomic absorption, spark source mass spectrometry, optical emission spectrometry, anodic stripping voltammetry, and X-ray fluorescence. The results from the interlaboratory comparison were evaluated to assess the comparability of various methods as applied to these matrices. The wide range in reported concentrations indicates that different sample preparation and analytical techniques can lead to erroneous results and points out the need for developing standard reference materials certified in trace elements which can be used for analytical methods evaluation and quality control. Future reports will describe the optimal analytical methods which should be used. (auth)

15270 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS FOR MERCURY IN DOGS ADMINISTERED METHYLMERCURY CHLORIDE: USE OF A LOW ENERGY PHOTON DETECTOR. Friedman, M. H.; Miller, E.; Tanner, J. T. (Food and Drug Administration, Washington, DC). Anal. Chem.; 46: No. 2, 236-239(Feb 1974).

Mercury was determined by nondestructive neutron activation analysis in samples of brain tissue from beagles fed methylmercury chloride. The mercury concentration was not uniformly distributed throughout the central nervous system and the fastest rise in concentration occurred in components of the visual system. The analytical procedure was capable of measuring mercury instrumentally and routinely in small samples of biological materials at approximately the 0.2-ppM level within a few days after irradiation with short counting times. Comparative measurements showed that mercury determination based on ^{197}Hg could be done with greater sensitivity by using a Ge(Li) low-energy photon detector rather than a conventional high-resolution, high-efficiency coaxial Ge(Li) detector. (auth)

15271 DETERMINATION OF THE NOBLE METALS IN GEOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Nadkarni, R. A.; Morrison, G. H. (Cornell Univ., Ithaca, NY). Anal. Chem.; 46: No. 2, 232-236(Feb 1974).

Gold, ruthenium, palladium, osmium, iridium, and platinum were determined in geological materials using thermal neutron irradiation, selective adsorption of the noble metal group on Srafion NMRR ion exchange resin, and high-resolution gamma spectrometry. The method was used to analyze three USGS standard rocks, a meteorite, and a lunar soil sample. (auth)

15272 ANALYSIS OF MERCURY CONTENT IN GAME 1968–1970. Holt, G. Fauna (Oslo); 26: No. 1, 38-58(1973). (In Norwegian).

Comprehensive studies of mercury concentrations in game were begun in Norway in 1965. The results from the period 1965–1967 have been published previously by the same author. The samples of muscle, kidney and brain from ducks, crows, magpies, pigeons, grouse, gulls, and several birds of prey, including owls, as well as lynx and wolverine, were analyzed by neutron activation analysis. The results from the period 1968–1970 are presented and commented on and the method of analysis briefly described. (NO)

15273 MEASUREMENT OF CALCIUM IN RATS BY TOTAL BODY NEUTRON ACTIVATION ANALYSIS. Skukla, K. K.; Cohn, S. H. (Brookhaven National Lab., Upton, NY). Int. J. Nucl. Med. Biol.; 1: No. 2, 73-78(Nov 1973).

Total-body neutron activation analysis (TBNAA) was used for the measurement of total-body calcium in rats. The thermal neutron beam from the Brookhaven Medical Research Reactor was used as the neutron source. The variation in depth flux density from this beam was ±4.5% through a rat phantom if it was rotated during irradiation. This in-vivo neutron activation technique for measuring Ca was shown to have an accuracy of ±1.32% in a rat phantom. In three rats the mean total body Ca was found to be 785 ± 9.3 (S.E.) mg per 100 g of rat weight. Chemical analysis performed after TBNAA on the same rats indicated a mean Ca level of 839 ± 7.2

mg/100 mg. The Ca level determined by TBNAA was systematically lower than the level determined by direct chemical analysis (6.3%) in the three rats. Study with uremic rats is in progress using TBNAA to establish the rate of loss of Ca from the body and also the partition of Ca between the skeletal pool and soft tissue pool. It is suggested that this study should provide significant information in the management of uremic patients. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 15347, 15418, 16198, 17973, 17977, 17985, and 17988.

15274 (EURISOTOP-72, pp 519-568) STABLE ISOTOPE DILUTION: A POSSIBLE TOOL FOR THE ANALYTICAL CHEMISTRY OF NOBLE METALS. De Bievre, P. (Central Bureau for Nuclear Measurements, Geel, Belg.). 1973.

From symposium on nuclear analysis techniques in the production and industrial use of noble metals; Brussels, Belgium (16 Nov 1971).

Stable isotope dilution mass spectrometry is discussed. Although the method has not been applied to noble metals, it is felt that it could be useful in noble metal analytical chemistry. (LK)

15275 (EURISOTOP-72, pp 569-608) TRACE ANALYSIS OF PLATINUM AND GOLD WITH THE HELP OF SPARK MASS SPECTROSCOPY. Beske, H. E. (Kernforschungsanlage, Juelich, Ger.). 1973. (In German).

From symposium on nuclear analysis techniques in the production and industrial use of noble metals; Brussels, Belgium (16 Nov 1971).

The characteristics of the spark mass spectrometric analysis method are summarized. The application of this method to the analysis of Pt and Au is described and typical results obtainable are tabulated. (JSR)

15276 (INIS-mf-940) SEPARATION AND CONCENTRATION OF MICROCONSTITUENTS FROM URANIUM BY HIGH-MOLECULAR-WEIGHT AMINE EXTRACTION IN HCl–KI MEDIUM. de Moraes, S. (Sao Paulo Univ. (Brazil). Instituto de Quimica). 1972. 48p. (In Portuguese). INIS.

Thesis.

It has been demonstrated that the addition of KI to uranyl chloride solutions improved the extraction of the elements cadmium, silver, gold, mercury, lead and bismuth, occurring as traces in ammonium diuranate. The long-chain amine tri-n-octilamine dissolved in benzene is utilized to achieve that extraction. This technique was shown to be excellent because all six elements are transferred together to the organic phase and determined without any interference by atomic absorption spectrophotometry. The extractions in HCl and HCl-KI media and TOA-benzene were compared. Two types of gaseous mixture for vaporizing and atomizing the elements were studied. The H_2-air mixture used in total consumption burner has demonstrated great advantage. The method is very reproducible and is of great applicability and utility. This method is being used routinely to perform the quality control of ammonium diuranate produced at the Chemical Engineering Division of Atomic Energy Institute. (INIS)

15277 STANDARD METHODS OF CHEMICAL ANALYSIS OF ZIRCONIA REFRACTORIES. 1973 Annual Book of ASTM Standards. Part 13. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-C-705-72).

The methods are for either zirconia or zirconia stabilized with alkaline earths (Ca or Mg). The analysis covers moisture, SiO_2, Zr, Fe, Ti, Al, oxides, lime, etc. (DLC)

15278 ATOMIC ABSORPTION SPECTROMETRY OF EUROPIUM AND YTTERBIUM IN AIR-HYDROGEN FLAME. Ishizuka, T.; Sunahara, H. (Government Industrial Research Inst., Nagoya, Japan). Jap. Anal.; 22: No. 7, 899-904(Jul 1973). (In Japanese).

The atomic absorption behavior of europium and ytterbium was studied in an air-hydrogen flame as a cool flame. The effects of inorganic acids in the range of 0.01 to 2.5 *M* on the absorption of europium (300 ppM) and ytterbium (30 ppM) were investigated. The effects of metal ions in the range of 10 to 5000 ppM on the absorption of europium and ytterbium were investigated. The absorption of europium increased in the presence of potassium of 10 to 1000 ppM, and that of ytterbium decreased with increasing the concentration of potassium. Magnesium and aluminum remarkably suppressed the absorption of both the elements, but the interferences with the absorption of europium were eliminated by adding 1% lanthanum. The absorption of europium gradually decreased with increasing the concentration of calcium, and that of ytterbium decreased by 80% in the presence of calcium of 100 to 5000 ppM. The absorption of both the elements decreased with increasing the concentration of Cr, Mn, Fe, and Pb. The absorption of europium increased by 20% in the presence of La and Nd more than 100 ppM, and by 50% in the presence of Sm of 1000 ppM, but that decreased with increasing the concentration of Y and Dy. The absorption of ytterbium decreased with increasing the concentration of Y, La, Eu, Dy, and Er. The calibration curve for europium was linear in the range of 0 to 400 ppM. The calibration curve obtained by adding 0.1 *M* perchloric acid showed a sensitivity of 2.7 times in comparison with that for europium alone. The calibration curve for ytterbium obtained by adding 0.1 *M* perchloric acid showed a sensitivity of 4.5 times that for ytterbium alone and of 1.8 times that for ytterbium obtained in a nitrous oxide-acetylene flame. Europium in synthetic or practical samples of rare earth oxide was determined by atomic absorption method using the air-hydrogen flame. A sample was dissolved by perchloric acid, and europium in the sample solution was determined. (auth)

15279 REDETERMINATION OF LEAD ISOTOPIC COMPOSITION IN CANYON DIABLO TROILITE. Oversby, V. M. (Australian National Univ., Canberra). Geochim. Cosmochim. Acta; 37: No. 12, 2693-2696(Dec 1973).

Redetermination of the lead isotopic composition in Canyon Diablo troilite shows that the original analysis was overcorrected for analytical fractionation. The new analysis indicates that the lead in nodule CDN-1 is a mixture of primordial lead plus a small amount of common lead. (auth)

15280 VOLTAMMETRIC DETERMINATION OF MOLYBDENUM IN THE PRESENCE OF TUNGSTEN. Monien, H.; Jacob, P.; Jaenisch, B. (Univ., Dortmund, Ger.). Z. Anal. Chem.; 267: No. 2, 108-114(1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Ger. (2 Apr 1973).

The complex compound of molybdenum with sodium diethyldithiocarbamate is reducible at the carbon paste electrode in a base electrolyte containing acetate buffer. The height of the reduction peak with the peak potential near -0.25 V (SSE) is proportional to the molybdenum concentration in the range between 5 and 50 ng/ml. Pre-electrolysis is carried out 3 min in open circuit starting the potential scan at +0.4 V (SSE). In determining 50 ng/ml molybdenum, the relative standard deviation was found to be 0.035 (3.5%). A 10^6 fold excess of tungsten does not interfere with the determination. Possible interferences of 18 elements were investigated. The method described allows the determination of 1 to about 100 ppM of molybdenum in sodium tungstate. Using the addition technique, the entire analysis takes 30 min. (GE)

15281 DETERMINATION OF IODINE IN THE NANOGRAM RANGE WITH THE SANDELL–KOLTHOFF REACTION. Matthes, W.; Kiss, T.; Stoeppler, M. (Kernforschungsanlage, Juelich, Ger.). Z. Anal. Chem.; 267: No. 2, 89-95(1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Ger. (2 Apr 1973).

A method for the determination of iodine in biological materials based on the Sandell-Kolthoff reaction was studied. For the alkaline mineralization and some further steps with regard to iodine losses and reproducibility, ^{131}I tracer was applied and a modified procedure was developed. In the case of grass samples, the standard deviation was found to be 7%. (GE)

15282 DETERMINATION OF IMPURITIES IN HIGH PURITY TELLURIUM. V. Spectrophotometric Determination of Traces of Lead and Bismuth with Dithizone by Reversion-Bichromatic Method and by Using Standard Addition as Background. Kasterka, B.; Kwiatkowska-Sienkiewicz, K. (Technical Univ., Danzig). Chem. Anal. (Warsaw); 18: No. 6, 1153-1160(1973). (In Polish).

A spectrophotometric method for simultaneous determination of traces of lead and bismuth in high-purity tellurium with dithizone dissolved in carbon tetrachloride was elaborated. In the condensation process of determining the traces, tellurium was isolated preliminarily as $TeO_2 \cdot nH_2O$ and then lead and bismuth were extracted successively with dithizone in presence of citrate and cyanide, the optimum pH being 8.5 ± 0.3. Bismuth was separated from lead by means of decomposition of lead dithizonate by applying ammonium chloride solution at pH 3.5. Lead was determined by reversion technique on the basis of liberated dithizone at absorbance amounting to 620 nm. Bismuth was determined by the bichromatic-nomograph method. The absorbance of the extract was measured with a spectrophotometer at two wavelengths: 510 nm and 620 nm, respectively. In the presence of the spectral purity standard by using the least squares method there were determined in tellurium 5N Te $-2.62 \pm 0.95\ 10^{-5}$% of lead and $1.52 \pm 0.82\ 10^{-5}$% of bismuth (the confidence level of 99% for n = 7). The significance of the determination has been verified by a bilateral-t-Student test. The concentration coefficient for lead is 1.29×10^2 and for bismuth 1.21×10^2. (auth)

15283 CONTRIBUTION TO THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN THE PRESENCE OF THORIUM. Sulcek, Z.; Sixta, V.; Yusaf, M. (Geologisches Zentralinstitut, Prague). Collect. Czech. Chem. Commun.; 38: No. 10, 2926-2930(Oct 1973). (In German).

For uranium determination in the presence of excess thorium ions, a method was elaborated with arsenazo III as reagent. The Th^{4+} reaction with the coloring agent was masked through the addition of triethylenetetramine-N,N,N',N'',N''',N'''-hexaacetic acid in a medium of 0.6 M NaCl and 0.5 M chloracetic acid buffer at pH 2.1. Under these conditions, uranium could be determined in the presence of a two thousand-fold thorium excess. (tr-auth)

15284 DETERMINATION OF ^2H_2O IN WATER AND BIOLOGICAL FLUIDS BY GAS CHROMATOGRAPHY. Bocek, P.; Deml, M.; Tesarik, K. (Inst. of Instrumental Analytical Chemistry, Brno). J. Chromatogr.; 87: No. 1, 246-249(5 Dec 1973).

The methods for determining ^2H_2O are essentially direct methods, where ^2H_2O itself is determined, and indirect methods, where the sample containing ^2H_2O is decomposed into a gaseous mixture of hydrogen isotopes which is then analyzed for deuterium content. Three methods of decomposition were studied: electrolysis, by means of a pre-column filled with $LiAlH_4$, and by means of $LiAlH_4$ in a generating tube. Reproducibility and sensitivity of the gas chromatographic analysis were best with samples from the third method of decomposition. Sensitivity of the method, expressed as the minimum detectable concentration of ^2H_2O in a liquid sample, was 0.03 wt % of ^2H_2O. (LK)

15285 TRACE DETERMINATION OF DIBUTYL PHOSPHORIC ACID BY GAS CHROMATOGRAPHY. Saey, J. C. (CEN, Fontenay-aux-Roses, France). J. Chromatogr.; 87: No. 1, 57-65 (5 Dec 1973). (In French).

The determination of traces of dibutyl phosphoric acid in mixtures of tributyl phosphate and technical grade dodecane was investigated by gas chromatography. A peak cutting technique involving the use of three columns and two different stationary phases for separation following methylation is presented. The calculated uncertainties in the results of the chromatographic analysis for three determinations are approximately: 16% for concentrations of about 10^{-4} mol/l; 9% for concentrations of about $5 \cdot 10^{-4}$ mol/l; 1.5% for concentrations of about $5 \cdot 10^{-3}$ mol/l. (auth)

15286 PHOTOMETRIC DETERMINATION OF Nb IN STEELS WITH PAR. Slama, J. (Statni Vyzkumny Ustav Materialu, Prague). Hutn. Listy; 28: No. 5, 365-366(May 1973). (In Czech).

Use of 4-(2-pyridylazo)-resorcinol (PAR) in the photometric determination of 0.2 to 3% of Nb in Zr steels is described. A detailed description is presented of the Nb determination procedure in a 1 g sample by means of a calibration curve. The amount of W up to 5%, Ti up to 5%, Ta up to 1.6%, and Zr up to 1% did not affect the determination. (INIS)

15287 DETERMINATION OF RUBIDIUM AND CESIUM IN MINERALS WITH A FLAME SPECTROMETER. Rubeska, I.; Miksovsy, M. (Inst. of Geophysics, Prague). Chem. Listy; 67: No. 11, 1197-1202(Nov 1973). (In Czech).

The possibilities of absorption and emission flame spectrometry of Rb and Cs determination in silicates with the use of a single apparatus only are investigated. For rubidium, the absorption method is more suitable because the spectral interference of potassium does not take place, which in the emission method impairs the determination. On the contrary, for cesium the emission method which has a lower limit of detection is more advantageous. For the decrease of spectral interferences of sodium, calcium, and potassium an optical filter is inserted in the optical axis of the apparatus behind the flame. This filter absorbs the radiation below 800 nm. (auth)

15288 SELECTION OF OPTIMAL CONDITIONS FOR DETERMINATION OF A TELLURIUM IMPURITY IN SEMICONDUCTOR ALLOYS. Kopanskaya, L. S.; Russu, A. T. (Inst. of Chemistry, Kishinev, USSR). Zh. Anal. Khim.; 28: No. 11, 2182-2187(Nov 1973). (In Russian).

The effect of the tellurium concentration, electrode size, accumulation time, and rate of changing the voltage on the tellurium peak height in the determination of the element by the method of polarography with accumulation has been studied by factorial planning. Optimal conditions have been found for polarographic determination of tellurium. A method is suggested for determining $n \cdot 10^{-4}$% Te in indium antimonide alloyed with tellurium and $n \cdot 10^{-3}$% Te in indium phosphide with the relative error of ±9% and ±12%, respectively. (auth)

15289 EFFECT OF SILVER CHLORIDE DIAMMINE ON SPECTRAL DETERMINATION OF NIOBIUM AND TANTALUM OXIDES. Tarasevich, N. I.; Semenenko, K. A.; Solodova, E. K. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 11, 2247-2251(Nov 1973). (In Russian).

A method has been suggested and conditions studied for the transportation of silver chloride into a source of the spectrum excitation by impregnating the electrodes with silver chloride diammine. The effect of silver chloride on kinetic parameters in the evaporation of refractory niobium and tantalum oxides from carbon powder and on the intensity of spectral lines of the elements has been studied. A limit of the sensitivity of determining tantalum and niobium on carbon powder has been found to be $2 \cdot 10^{-4}$ and $1 \cdot 10^{4}$% Nb and Ta respectively, an order more than in the absence of an additive. (auth)

15290 REDUCTION OF MOLYBDENUM(V) ON A MERCURY DROPPING ELECTRODE IN THE PRESENCE OF HYDROCHLORIC ACID. Ivanova, Z. I.; Chernikova, E. N.; Lektorskaya, N. A. (Rostov State Univ., USSR). Zh. Anal. Khim.; 28: No. 11, 2202-2205(Nov 1973). (In Russian).

The oscillopolarographic behavior of Mo(V) in the presence of HCl has been studied. It has been shown by the method of $i'-\tau$ curves and calculation of Semerano criterion that the process of reducing Mo(V) is similar to a diffusion one and does not depend on acid concentration in a wide range (0.1–4M). Molybdenum(V) has been determined in pure salts under optimal conditions. The error is 2.6%. (auth)

15291 CATALYTIC EFFECT OF Ru COMPOUNDS ON Cu(II) OXIDATION BY PERIODATE. Rozovskii, G. I.; Poshkute, Z. A.; Prokoptchik, A. Yu. (Inst. of Chemistry and Chemical Technology, Vilnyus, USSR). Liet. TSR Moksl u Akad. Darbai, Ser. B; 3: No. 76, 3-11(1973). (In Russian).

The kinetics of Cu(II) oxidation to Cu(III) by periodate, catalyzed by Ru compounds, was investigated; $H_3IO_6^{2-}$ oxidizes Ru ions and the oxidized form is reduced by Cu(II). The reaction product is an intensive colored diperiodatocuprate(III). The dependence of the reaction rate on pH and $[H_3IO_6^{2-}]$ is typical of the reactions in which reactants are inhibitors simultaneously. The inhibiting action is explained by the formation of catalytically non-active Ru(VII) diperiodate complex. It was established that at the initial Cu(II) concentration $(2-8) \cdot 10^{-5}$ M and pH = 11.9 to 12.75 the Cu(II) oxidation reaction is of the 1st order in Cu(II). With the increasing Cu(II) concentration and pH, order of the reaction increases. The reaction is of the 1st order in Ru and it can be used for determination of Ru microquantities by the kinetic method (the sensitivity of the reaction $\sim 3 \cdot 10^{-4}$ μg/ml). (auth)

15292 ATOMIC-ABSORPTION DETERMINATION OF Li, Ca, Na, Mg, Mn, Sr, Cu, Ni, Zn, Cr, AND Fe IN ROCKS AND MINERALS. K'o Hsueh T'ung Pao; 18: No. 1, 27-29(Jul 1973). (In Chinese).

Atomic absorption spectrometry has good discrimination and high sensitivity. It has been used for analyzing minerals since 1955. However, a large number of elements are known to interfere with these analyses. In this paper, the interferences are overcome by using an oxidizing, air-acetylene flame and by adding small amounts of $SrCl_2$ (for Ca, Mg), Na_2SO_4 (for Cr), or $CaCl_2$ (for Sr) to enhance the absorption signal. Experimental results indicate that this method is very accurate. When compared with the average results of several other methods, the relative error ranges from 0.3% for MgO to 6.5% for MnO. (JPRS)

15293 SEPARATION AND DETERMINATION OF TRACES OF RARE EARTH ELEMENTS IN NICKEL-BASE ALLOYS AND ALUMINUM ALLOYS. P'eng, C. L. K'o Hsueh T'ung Pao; 18: No. 4, 170-173(Oct 1973). (In Chinese).

A new method for extraction of rare earth elements in nickel-base alloys and aluminum alloys is presented. The masking agent used is composed of 100 ml of 60% thiocyanate, 10 ml of 60% sulfosalicylic acid, 120 ml of pH 5.5 acetate, and 370 ml of water. PMBP is used to separate the rare earth elements. The effects of the concentration of the masking agent, the acidity of the solution, and timing of the extraction process are investigated. Experimental results on nickel-base alloys, aluminum alloys, thorium nitrate, and phosphorus rock show that the method has good accuracy. (JPRS)

15294 AMPEROMETRIC TITRATION OF MOLYBDENUM(VI) BY FERROCENE SOLUTIONS IN AQUEOUS-ORGANIC MEDIA. Solomatin, V. T.; Yakovlev, P. Ya.; Artemova, T. N.; Lapshina, L. A. (Central Scientific-Research Inst. of Non-Ferrous Metallurgy, Moscow). Zh. Anal. Khim.; 28: No. 11, 2197-2201(Nov 1973). (In Russian).

Ferrocene is suggested as a reagent for direct amperometric oxidation-reduction titration of molybdenum(VI) in aqueous-organic media. Oxidation-reduction potentials for the Mo(VI)/Mo(V) system have been measured depending on the nature and concentration

of the acid and organic solvent. A procedure has been developed for determining molybdenum in steel. (auth)

15295 METAL ARSENATES AS COLLECTORS (COPRECIPITANTS). Determination of Zirconium Microimpurities in Zinc and Cadmium Salts with the use of Concentration by Coprecipitation. Chmilenko, F. A.; Smirnaya, V. S.; Chuiko, V. T. (Dnepropetrovsk State Univ., USSR). Zh. Anal. Khim.; 28: No. 11, 2176-2178(Nov 1973). (In Russian).

Zirconium microimpurities are quantitatively precipitated with zinc and cadmium arsenates from solutions of the metals. Methods for determining zirconium traces (down to $1 \cdot 10^{-7}$%) in zinc and cadmium salts and their purification from zirconium (down to $1 \cdot 10^{-8}$%) have been worked out. (auth)

15296 DIFFERENTIAL TITRATION OF NONAQUEOUS SOLUTIONS OF MAGNESIUM, CALCIUM, STRONTIUM, AND BARIUM SALTS BY THE AUTOMATIC POTENTIOMETRIC METHOD. Milaev, S. M.; Komarova, K. A.; Kreshkov, A. P.; Baldanov, M. M. (Moscow Chemical-Technological Inst.). Zh. Anal. Khim.; 28: No. 11, 2157-2161(Nov 1973). (In Russian).

Acid-base properties of nonaqueous solutions of salts of alkaline earth elements were studied. Magnesium, calcium, strontium, and barium bromides, chlorides, iodides, nitrates, and perchlorates behave as acids of different strength in media of alcohols, ketones, dimethyl formamide and their mixtures. Methods were developed for direct and indirect titration of individual magnesium, calcium, and strontium salts and analytical methods for two-, three- and four-component salt mixtures in the presence of corresponding acids. (auth)

15297 ISOBUTANE CHEMICAL IONIZATION MASS SPECTRA OF VOLATILE LANTHANIDE CHELATES. Risby, T. H. (Pennsylvania State Univ., University Park); Jurs, P. C.; Lampe, F. W.; Yergey, A. L. Anal. Chem.; 46: No. 1, 161-164(Jan 1974).

The separation and analysis of rare earth chelates were studied by chemical ionization mass spectrometry, which produces mass spectra of compounds in which ions from the molecules of interest are formed by ion molecule reactions. This technique has the advantage that relatively little fragmentation takes place, especially if isobutane is used as the reagent gas. Isobutane chemical ionization mass spectra of the chelates of Eu, Yb, and a mixture of Er, Tm, Yb, and Lu are given. (LK)

15298 DYE LASER INTRA-CAVITY ENHANCED ABSORPTION MEASURED USING A PHOTODIODE ARRAY DIRECT READING SPECTROMETER. Horlick, G.; Codding, E. G. (Univ. of Alberta, Edmonton). Anal. Chem.; 46: No. 1, 133-136(Jan 1974).

Solutions of $Pr(NO_3)_3$, $Eu(NO_3)_3$, $NdCl_3$, and $HoCl_3$ were used to study the dye laser intra-cavity enhanced absorption as a function of concentration. The results indicate that there is a linear relationship between apparent absorbance and concentrations. (LK)

15299 STABLE ISOTOPE DILUTION APPLIED TO THE DETERMINATION OF ZIRCONIUM IN GEOLOGICAL AND LUNAR SAMPLES. Tsuge, S.; Leary, J. J.; Isenhour, T. L. (Univ. of North Carolina, Chapel Hill). Anal. Chem.; 46: No. 1, 106-110 (Jan 1974).

The method of metal labeled stable isotope dilution (ML-SID) is developed in detail. This technique is then applied to the microdetermination of zirconium in standard geological and lunar samples as the volatile chelate tetrakis (1,1,1,2,2,3,3-heptafluoro-7, 7-dimethyl-4,6-octanedionato) Zr(IV) [$Zr(fod)_4$] by means of a mass spectrometer equipped with a voltage peak switching facility. Samples analyzed include a USGS standard (AGV-1), a CAAS standard (SY-1), and five Apollo 14 and 15 samples (14310,135; 14321,188: 15021,96: 15301,78: and 15471,30). This method of zirconium determination requires only small samples (10–40 mg), can be performed using an ordinary electron impact mass spectrometer, and is essentially free from matrix interferences. (auth)

15300 INDUCTIVELY COUPLED PLASMA-OPTICAL EMISSION ANALYTICAL SPECTROMETRY. Scott, R. H.; Fassel, V. A.; Kniseley, R. N.; Nixon, D. E. (Ames Lab., IA). Anal. Chem.; 46: No. 1, 75-80(Jan 1974).

A compact inductively coupled plasma-optical emission system for the trace determination of metallic elements in solution is described. Theoretical considerations are presented to determine operating parameters that agree well with the empirically determined values. The aerosol desolvation system commonly used with this type of source has been eliminated, and pneumatic nebulization is employed in place of the more elaborate ultrasonic method. Some characteristics of the plasma are reported. Detection limits are in the range 0.1–10 ng/ml for most elements studied. The present facility is readily adaptable to simultaneous multi-element trace analysis. (auth)

15301 CONCENTRATION AND DETERMINATION OF TRACE IMPURITIES IN COPPER BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Reichel, W.; Bleakley, B. G. (Canadian Copper Refiners Ltd., Montreal). Anal. Chem.; 46: No. 1, 59-61(Jan 1974).

A simple coprecipitation technique for the quantitative separation and concentration of trace impurities in anode and blister copper is described. Lanthanum hydroxide is employed as the collector. Trace quantities of selenium, tellurium, arsenic, antimony, iron, lead, tin, and bismuth are separated from the copper matrix and subsequently determined by atomic absorption spectrophotometry from a single sample solution. Minor interferences caused by impurities and small amounts of coprecipitated copper are overcome by inclusion of calculated amounts of copper into multi-element standards. Quantitative recoveries with relative standard deviations under 3% have been obtained. The procedure effects considerable saving in time compared to traditional methods and is at least of comparable accuracy. A study of the behavior of lanthanum hydroxide on the precipitation of selenium is presented. (auth)

15302 NEW ELECTROCHEMICAL TECHNIQUE FOR THE SEPARATION OF LEAD AT TRACE LEVELS FROM NATURAL SILICATES. Arden, J. W.; Gale, N. H. (Oxford Univ.). Anal. Chem.; 46: No. 1, 2-9(Jan 1974).

A rapid low blank method is described for the separation of lead by sequential cathodic and anodic deposition from a variety of matrices, especially complex natural silicates. The technique is especially suitable as a separative step for subsequent mass spectrometric isotopic analysis and for lead concentration determination by mass spectrometric isotope dilution; it is applicable to samples containing 10 ng of lead upwards and the combined electroseparation is more than 95% efficient at these levels. Methods have been devised for overcoming all interferences, and the optimum conditions for both the cathodic and the anodic deposition of lead have been studied. A technique has been developed for the dissolution of natural silicates which ensures recovery of more than 99% of the lead which they contain. (auth)

15303 USING X-RADIATION LUMINESCENCE IN CHEMICAL ANALYSIS. De Kalb, E. L.; d'Sil'va, A. P.; Fassel, B. A. (Iowa State Univ., Ames). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 4, 790-794(Apr 1973). (In Russian).

X-ray luminescence makes it possible to determine small quantities of rare earth elements in compounds of 55 chemical elements if these compounds are inserted in a suitable phosphor. The analysis is produced with respect to the intensity of the luminescence of the element to be determined to the intensity of the luminescence of rare earth elements previously introduced in the phosphor. (tr-auth)

15304 THERMOMETRIC TITRATION IN INVESTIGATION OF THE FORMATION OF POLYANIONS OF MOLYBDENUM(VI), TUNGSTEN(VI), VANADIUM(V), AND CHROMIUM(VI). III. Titration of Molybdic Acid With Sodium Hydroxide Solution. Kiba, N.; Takeuchi, T. (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 46: No. 10, 3086-3090(Oct 1973).

To define the properties of molybdenum-containing species which appear in the acidification of neutral molybdate solution with mineral acid, the reverse process (i.e., the titration of molybdic acid of acidified molybdate solution with sodium hydroxide) was examined and the titration curves were obtained thermometrically as well as potentiometrically. In the thermometric titration curves there are inflections not found on the pH-titration curves of the same systems. Titration curves of both methods change with molybdenum concentration, the reaction process being found to be responsible for the change. Polymolybdate anions were identified with the aid of the ultraviolet spectrophotometry of Punger et al. A neutral salt such as sodium perchlorate or lithium perchlorate was found to affect the shape of the thermometric titration curve, since in the presence of such salt octamolybdate ion was readily converted into heptamolybdate ion. (auth)

15305 INDUCTIVELY COUPLED PLASMA: OPTICAL EMISSION ANALYTICAL SPECTROSCOPY. Tantalum Filament Vaporization of Microliter Samples. Nixon, D. E.; Fassel, V. A.; Kniseley, R. N. (Ames Lab., IA). Anal. Chem.; 46: No. 2, 210-213(Feb 1974).

The adaptation of a tantalum filament vaporization system as a sample introduction device for the inductively coupled plasma is described. The potential advantages of this analytical system for simultaneous multielement determinations of elements at the ng/ml level are discussed and a comparison of the plasma system with the filament techniques utilized in atomic absorption or fluorescence spectroscopy is presented. For one set of operating conditions, detection limits for 16 elements were in the ng/ml

to fractional ng/ml range for 100-μl samples. Typical precision data and an analytical curve for the determination of Be in the range of 0.001 to 10 μg/ml are included. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 15553, 15615, 15631, 15636, 15656, 15675, 15691, 15707, 15726, 15729, 15744, 15745, 15785, 15796, 15814, 16067, 16092, and 16266.

15306 (ARH-2913) DETERMINATION OF TRACE QUANTITIES OF THORIUM IN URANYL NITRATE BY X-RAY EMISSION SPECTROMETRY. Winters, W. I. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2130. 32p. Dep. NTIS $4.00.

Trace quantities of thorium in uranium were separated by precipitating thorium fluoride from a 1.0M HF-1.0M NH_4F matrix using yttrium as an internal standard and lanthanum as a carrier. The thorium precipitate was collected on a filter and analyzed by x-ray emission spectrometry. The method has a detection limit of about 15 μg thorium per gram of uranium. The relative accuracy and precision at the 120-μg thorium level was 95.5 ± 1.5%. Studies on the rate of precipitation, sample size limitations, and the effect of varying molar fluoride-to-uranium ratios are discussed. The effects of potentially interfering anions, cations, and acids, which are commonly found in uranium system or form insoluble fluorides were studied. Radioactive tracer studies using ^{234}Th and ^{88}Y were carried out at different levels of thorium and uranium to determine the absolute efficiency of the precipitation. The speed, selectivity, and precision of this x-ray method make it an excellent alternative to spectrophotometric methods. (auth)

15307 (CEA-N-1667) ANALYTICAL DETERMINATION OF α EMITTERS (Pu, Am, AND Cm) IN FECES. Ballada, J.; Jeanmaire, L.; Nauche, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1973. 10p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

A technique based on the use of glass fiber filters was developed for determination of α emitters (Pu, Am, Cm) in feces. (FR)

15308 (CNEA-355) RADIOACTIVE MINERALS X-RAY DETERMINATION TABLE. Toubes, R. O.; Chaar, E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 17p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

X-ray spacings from radioactive minerals were recompiled and they complement a former publication (Inf. CNEA N°105, 1964). The four more intense spacings of each mineral are listed twice in decreasing order with regard to the two major intensity lines. Finally, the complete spacings of each species alphabetically appear, together with the chemical composition and bibliography. (auth)

15309 (EURISOTOP-72, pp 441-509) POSSIBILITIES OF THE APPLICATION OF THE RADIOACTIVE METHOD OF X-RAY FLUORESCENCE ANALYSIS IN THE PRECIOUS METALS INDUSTRY. Martinelli, P. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From symposium on nuclear analysis techniques in the production and industrial use of noble metals; Brussels, Belgium (16 Nov 1971).

Basic concepts on x-fluorescence analysis, which uses radioactive sources as a means of excitation, are reviewed. The possibilities offered by this method to the precious metals industry are discussed. There is a review and critical examination of published works and methods used. The possibilities of applying the x-fluorescence method to specific problems are discussed. (JSR)

15310 (EURISOTOP-72, pp 511-518) SOME USES OF RADIOISOTOPE-EXCITED X-RAY FLUORESCENCE ANALYSIS. Cesareo, R.; Frazzoli, F. V.; Mancini, C.; Sciuti, S.; Storelli, L. (Univ., Rome). 1973. (In German).

From symposium on nuclear analysis techniques in the production and industrial use of noble metals; Brussels, Belgium (16 Nov 1971).

The radiation sources used in the x-fluorescence analyzer are tabulated. The detection range for Ag, Hg, and Au with some of these sources is given. The use of this method in the nondestructive analysis of bronze, Au alloys, and Ag alloys is briefly indicated. (JSR)

15311 METHOD FOR THE ANALYSIS OF SURFACE LAYERS BY MEANS OF ANOMALOUS α-SCATTERING. Chernov, I.; Kuznetsov, V.; Starodub, G.; Yatis, A. (Polytechnical Inst., Tomsk, USSR). Radiochem. Radioanal. Lett.; 16: No. 1, 41-46 (31 Dec 1973).

A method for analysis of the differential and integral distribution of light elements admixed to the surface layer of materials is proposed here. The method is based on anomalous scattering of α-particles at projectiles energies above the coulomb barrier on light nuclei. It was found that the minimum numbers of admixed nuclei of carbon, nitrogen and oxygen, which can be determined, are 2×10^{13}, 1.5×10^{14} and 1×10^{13} nucl./cm^{+2}, respectively. In order to illustrate the possibilities of the method Nb and Ge matrices were investigated. The obtained results are reported here. (auth)

15312 LEAST SQUARES ANALYSIS AND MINIMUM DETECTION LEVELS APPLIED TO MULTICOMPONENT ALPHA EMITTING SAMPLES. Fisenne, I. M.; O'Toole, A.; Cutler, R. (Atomic Energy Commission, New York). Radiochem. Radioanal. Lett.; 16: No. 1, 5-16(31 Dec 1973).

The method of least squares analysis was applied to the estimation of lower limits of detection for multicomponent alpha-emitting samples. The lower limits of detection for ^{238}Pu and $^{239,240}Pu$ in the presence of ^{236}Pu tracer were determined for several activity levels. (auth)

15313 BURNUP DETERMINATION BY IRREVERSIBLE ADMIXING OF ACTIVABLE ISOTOPES TO NUCLEAR FUEL. Muench, E. Aachen; Technische Hochschule, Aachen (1970). 101p. (In German).

Thesis.

A method for the nondestructive determination of the burnup state of reactor fuel elements is described. By gamma spectroscopic analysis, besides the fission products, the activity of a fuel with an added activated isotope is measured. The activable isotope is not a fission product but has a large activation cross section and a sufficiently long half-life. The separation of the activated isotope from the fuel and fission products formed is not necessary after irradiation. From the activity, the fluence can be determined to which the isotope and simultaneously the fuel were exposed. The isotopes useful for the burnup determination are described. (GE)

15314 ELEMENTAL ANALYSIS OF AIRBORNE DUST BY ENERGY DISPERSIVE FLUORESCENT X-RAY SPECTROMETRY. Mizohata, A.; Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 16-22(Mar 1973).

A study was made to resolve some problems involved in the application of energy dispersive fluorescent x-ray spectrometry to elemental analysis of airborne dust samples collected on a membrane filter. In the attempt to determine simultaneously as many elements as possible, it should be remembered that the energy of characteristic x rays may extend in a considerably wide range even down to 1.0 keV. In order to make accurate quantitative multielement analysis it is absolutely necessary to grasp exactly the deviation from the proportionality relation that holds in a thin specimen between the counting rate of characteristic x-rays and the mass per unit area of the corresponding element present. For the purpose of determining the method of correction for specimens of medium thickness in which the above mentioned proportionality relation does not hold, thirteen airborne dust samples, whose dust mass per unit area varied in a range from 0.2 to 7.5 mg/cm^2, were subjected to both x-ray fluorescence analysis and instrumental neutron activation analysis, and the deviation from the proportionality was investigated. The experimental results thus obtained were compared with the theoretical relations obtained assuming appropriate absorption coefficients with dust. On the basis of these data, the twelve elements, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Br, and Pb, were determined for actual dust samples by excitation by ^{241}Am source. (auth)

15315 APPLICATIONS OF NUCLEAR RESONANCE FLUORESCENCE OF GAMMA RAYS TO ELEMENTAL ANALYSIS. Sowerby, B. D. (to Australian Atomic Energy Commission). US Patent 3,780,294. 18 Dec 1973. Priority date 6 May 1970, Australia. 8p.

A method is provided for using nuclear resonance fluorescence of gamma rays for element analysis. The method involves irradiating a sample with gamma rays of the required critical energy and at the same time detecting the resonantly scattered radiation from the sample. The technique is particularly adaptable to borehole prospecting, on-stream analysis in industry, the exploration of the ocean floor for mineral deposits, the analysis of the surface of planets, etc. (Official Gazette)

15316 METHOD FOR DETERMINING IODINE-129 IN MILK AND WATER. Gabay, J. J.; Paperiello, C. J.; Goodyear, S.; Daly, J. C.; Matsuszek, J. M. (New York State Dept. of Health, Albany). Health Phys.; 26: No. 1, 89-96(Jan 1974).

An analytical method for determining ^{129}I in environmental milk and water samples is described. The method depends on

the specificity of elemental iodine separation by solvent extraction, followed by liquid scintillation counting of the low-energy beta emissions from ^{129}I. Iodine, as iodide, is concentrated by sorption on an anion exchange column and eluted with NaOCl. After reduction to I_2, the iodine is extracted into CCl_4, back extracted into water, cleaned by one toluene-water extraction cycle, and finally extracted into toluene. Chemical recovery of the added carrier is determined spectrophotometrically on a small aliquot of the toluene extract. The ^{129}I concentration is determined by liquid scintillation counting of the toluene solution. Average % recovery of iodine carrier is 74 ± 2 for water, 58 ± 3 for raw milk, and 80 ± 4 for pasteurized milk. Analytical sensitivity is 0.3 pCi ^{129}I/l. for a 4 – 1. sample. (auth)

15317 MEASUREMENT OF LOW CONCENTRATIONS OF THE SHORT-LIVED RADON-222 DAUGHTERS IN THE AIR BY ALPHA SPECTROSCOPY. Jonassen, N.; Hayes, E. I. (Danmarks Tekniske Hoejskole, Lyngby). Health Phys.; 26: No. 1, 104-110(Jan 1974).

A method of measuring the concentrations of the short-lived ^{222}Rn daughters, ^{218}Po, ^{214}Pb, ^{214}Bi, and ^{214}Po, using α particle spectroscopy of filter samples is described and compared with previous methods. Preliminary measurements in an unventilated basement room are included. (UK)

15318 SIMULTANEOUS DETERMINATION OF ACTINIDE NUCLIDES IN ENVIRONMENTAL MATERIALS BY SOLVENT EXTRACTION AND ALPHA SPECTROMETRY. Hampson, B. L.; Tennant, D. (Ministy of Agriculture, Fisheries and Food, Lowestoff, Eng.). Analyst; 98: No. 1173, 873-885(Dec 1973).

Actinide analysis based on the selection of groups, instead of separation of individual elements, was applied to monitoring and control of the increasing variety and amounts of actinide nuclides in environmental materials contaminated by controlled discharges of liquid wastes. Multi-element actinide analysis is achieved by extracting the whole group, or part of it, in the tri-n-octylphosphine oxide-n-heptane–nitric acid–sodium nitrate system, stripping into ammonium carbonate solution and electrodeposition, followed by solid-state alpha spectrometry, with unusual actinide nuclides as yield tracers. This system gives efficient separation from virtually all common elements. Common operations for the several functions of sample dissolution, tracer exchange, solvent extraction, and electrodeposition have been developed, which are suitable for the group from actinium to curium. Detailed procedures, with variations, for simultaneous measurement of these actinides are stated, in order to allow application to biological materials and radioactive effluents in two combinations, the first in valency states III, IV and VI, and the second in valency states IV and VI with valency state III eliminated. They have been fully evaluated for plutonium-239 plus-240 with plutonium-236 as tracer, and americium-241 with americium-243 as tracer, and the scope is indicated for other members of the group. Up to 2 kg of edible seaweed or 10 kg of fish flesh can be handled, with detection limits (in terms of activity to double background) of 2×10^{-6} and 4×10^{-7} pCi/g, respectively, for a 1-week counting time. Sensitivities for precision with 4% standard deviation are 4×10^{-4} and 8×10^{-5} pCi/g, respectively, which corresponds to levels associated with fallout. (auth)

15319 SENSITIVE METHOD FOR THE DETERMINATION OF LOW URINARY PLUTONIUM LEVELS IN OCCUPATIONALLY EXPOSED WORKERS. Testa, C.; Santori, G. (CNEN, Casaccia, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 1, 1-6(1972). (In Italian).

The perfection of a sensitive and selective method for the periodic control of occupationally exposed personnel is presented. A liter of urine is used. Batch extraction of Pu(IV) is carried out in a nitric acid atmosphere with Microtene-710 (a microporous polyethylene) supporting tri-n-octylphosphine oxide (TOPO). Reelution is obtained by reduction to Pu(III) with a mixture of hydrochloric and hydroiodic acid. After drying and recovery with sulfuric acid, plutonium is electrodeposited on a steel disk for 5 hr, using $(NH_4)_2SO_4$. The disk is then counted with a solid-state detector with a background of about 0.001 cpm. When high values are present, alpha spectrometry can also be carried out. The method gives a yield of 72.5%. Polonium, thorium, neptunium, uranium, protactinium, americium, curium, and radium decontamination factors range from 30 to 10,000. Blanks activity (0.07 pCi/24 hr) was in line with the reference value adopted (0.2 pCi/24 hr). By comparison with anionic exchange resin analysis, the new method offers improved thorium and uranium decontamination. It also gives a similar chemical yield in a shorter execution time. (auth)

15320 ANALYSIS OF TANTALUM–NIOBIUM COMPOUNDS BY RADIOMETRIC METHODS. A Method of Calibration Curves with the use of Solvent Extraction of Organic Complexes of Niobium and Tantalum. Shamaev, V. I.; Savkin, M. E. (Moscow Chemical-Technological Inst.). Zh. Anal. Khim.; 28: No. 11, 2235-2238(Nov 1973). (In Russian).

Methods were developed for determining tantalum in niobium and niobium in tantalum by using 8-hydroxyquinoline as extractant. The occurrence of polymerization and copolymerization of niobium and tantalum in acidic solutions has been experimentally confirmed. (auth)

15321 RADIOISOTOPE APPLICATIONS IN CHEMISTRY: A REVIEW. Gorski, L. (International Atomic Energy Agency, Vienna). pp 377-381 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

Various methods of application of radioisotopes in chemistry, the most important use of the latter being that as tracers, are characterized; the necessity of knowledge of nuclear data for the individual applications is briefly discussed. (auth)

15322 DETERMINATION OF THE CONCENTRATION OF CHEMICAL SOLUTIONS IN THE FABRICATION PROCESS BY BACKSCATTERING OF β RADIATIONS. Marcu, G.; Sacelean, V. (Inst. of Chemistry, Cluj). (1973). vp. (In French).

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

By consideration of several studies and investigations on the backscattering of β^- particles, it was shown that in the analysis of solutions in industrial manufacture using these methods good results can be obtained by the determination of the intensity changes in the backscattering of β^- radiation as a function of the backscattering factor of the solution. It was established that between these magnitudes there is always a linear relation. (GE)

15323 QUANTITATIVE DETERMINATION OF BENZO[A]-PYRENE IN TAR-CONTAINING DRUGS BY AN ISOTOPE DILUTION METHOD. Masuda, Y.; Shimamura, K.; Kagawa, R. (Daiichi Coll. of Pharmaceutical Sciences, Fukuoka). Jap. Anal.; 22: No. 11, 1424-1427(Nov 1973). (In Japanese).

Quantitative determination of benzo[a]pyrene (BP) in tar-containing drugs was studied by employing tritiated BP instead of ^{14}C-BP. The analytical procedure was examined as follows: solvent extraction, thin-layer chromatography, and ultraviolet absorption spectrophotometry. The recovery of BP in the whole analytical procedure was examined by repeating the procedure after adding 4.4 or 33.0 μg of BP to Ichthammol which was found to contain less than 0.05 ppM of BP. According to this test, the overall recovery of this method was close to 100%. As the specific activity of ^3H-BP was much higher than that of ^{14}C-BP used in the conventional isotope dilution methods, the amount of added ^3H-BP could be very small without influencing the ultraviolet absorption spectrum to any extent. Therefore, ^3H-BP is more suitable for determining a very small amount of BP. When the content of BP in a sample is too small to be detected by the spectrophotometry, the recovery ratio can be determined by measuring the radioactivity. In such a case the upper limit of the BP content can be calculated from the recovery ratio and the known limit of detection in the spectrophotometry. Concentration of BP in four tar-containing drugs, pine tar, Pityrol pasta, Glyteer, and Ichthammol, was determined by this method as 9.72, 1.32, 12.90 and <0.05 ppM, respectively. The recovery ratios of BP in the analysis of the above-mentioned samples for BP varied from 30 to 80% and their deviation coefficients were from 15 to 30%. However, the deviation coefficients of BP concentrations corrected by this isotope dilution method became smaller, ranging from 4 to 9%. (auth)

15324 DETERMINATION OF SULPHUR CONTENT IN LIQUID HYDROCARBONS BY X-RAY ABSORPTION. Machaj, B. (Inst. of Nuclear Research, Warsaw); Cameron, J. F.; Piper, D. G. Nukleonika; 18: No. 9, 431-437(1973).

A laboratory sulphur content gauge in liquid hydrocarbons is described. The instrument is based on absorption of Ag x-ray excited radiation in ^{241}Am/Ag secondary radiation source in transmission geometry. The measuring range of the gauge is 0 to 6% of sulphur content with an accuracy better than 0.03%. The gauge is intended for rapid determination of sulphur content by unclassified personnel. (auth)

Separation Procedures

Refer also to abstract 17299.

15325 PROCEDURES FOR THORIUM AND URANIUM EXTRACTION FROM CALCITE. Thompson, G. M. (Memphis State Univ., TN); Walker, R. L.; Carter, J. A.; Lumsden, D. N. Radiochem. Radioanal. Lett.; 16: No. 1, 53-56(31 Dec 1973).

Thorium recovery of up to 100% (85% ± 15%) was obtained with

a three-step process using anion exchange separation followed by LaF_3 precipitation and thenoyl trifluoroacetone extraction. (auth)

15326 MODEL EXPERIMENTS FOR A RAPID SEPARATION OF SUPERHEAVY ELEMENTS IN THE GASEOUS PHASE. Baechmann, K. (Technische Univ., Darmstadt, Ger.). (1973). vp. (In German).

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

The most important parameters of a rapid gaseous-phase separation of superheavy elements produced by nuclear reactions were studied (gases for transport and reaction, temperature of the transport distance and of the cooling trap, flow velocity, wall material) using the separation of spontaneous fission products of ^{252}Cf as well as of decay products of ^{226}Ra as a model experiment. (GE)

15327 ELUTION BEHAVIOR OF THE RARE EARTH ELEMENTS ON SINGLE AND MIXED ION-EXCHANGE COLUMNS. Hayashi, T.; Yamabe, T. (Tokyo Univ.). J. Chromatogr.; 87: No. 1, 227-231(5 Dec 1973).

The separation of the rare earth elements with lactic acid at different pH values was carried out by using mixed ion-exchange columns. The elution behavior of rare earth elements in single and mixed columns is discussed. (auth)

15328 ION EXCHANGE IN THE ATOMIC ENERGY INDUSTRY WITH PARTICULAR REFERENCE TO ACTINIDE AND FISSION PRODUCT SEPARATIONS. Jenkins, I. L.; Wain, A. G. (Atomic Energy Research Establishment, Harwell, Eng.). Rep. Progr. Appl. Chem.; 57: 308-319(1972).

A list is given of publications covering the main uses of ion-exchange separations in the atomic energy industry; it is stated that these references are mainly to conference papers or reviews suitable as starting points for further reading on the various topics. Succeeding sections are entitled: ore processing; irradiated fuel processing; actinide purification and separation; uranium; neptunium; plutonium; protactinium and thorium; ^{241}Am and ^{243}Am; ^{242}Cm and ^{244}Cm; californium, einsteinium, and fermium. (UK)

15329 CATION-EXCHANGE CONCENTRATION OF RARE EARTH ELEMENT TRACES FROM NATURAL MATERIALS. Ryabukhin, V. A.; Stroganova, N. S.; Gatinskaya, N. G.; Ermakov, A. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 11, 2166-2170(Nov 1973). (In Russian).

The desorption of 9 elements from the KU-2 resin by 4 N HCl solution was studied by ion-exchange and radioisotope methods. Optimal conditions were found for separation of microamounts of REE (rare earth elements) from large amounts of Fe, Al, Mg, Ca, and other elements. A procedure is suggested for REE concentration from a number of rocks: earth and moon basalt and anortosite, peridotite, and iron minerals. The procedure increases the sensitivity of determining REE by two orders and more. (auth)

15330 ELECTROPHORETIC SEPARATION OF AMERICIUM AND PLUTONIUM. Ermolina, G. E.; Kharlamov, V. T. (Inst. of Biophysics, Moscow). Zh. Anal. Khim.; 28: No. 11, 2246-2247 (Nov 1973). (In Russian).

The electrophoresis with the use of 0.2 M citric acid solution as electrolyte at a potential gradient of 16 V/cm allows separation up to 10^{-4}% ^{241}Am from ^{239}Pu in 3 hr. (auth)

15331 SOLUBILITY AND SOLVENT EXTRACTION OF 8-HYDROXYQUINOLINATES OF RARE EARTH METALS. Pyatnitskii, I. V.; Gavrilova, E. F.; Gorenshtein, L. I. (Kiev State Univ.). Zh. Anal. Khim.; 28: No. 11, 2241-2243(Nov 1973). (In Russian).

The solubility of 8-hydroxyquinolinates of 10 rare earth metals in chloroform has been determined. It increases non-linearly with increasing the atomic number. The two-phase stability constants have been calculated by the data on the solubility of 8-hydroxyquinolinates of rare earths in water and chloroform. The solubility and extraction of rare earth 8-hydroxyquinolinates have been compared. (auth)

15332 SOME DYNAMIC CONSIDERATIONS OF A MULTISTAGE MIXER: SETTLER EXTRACTOR AND STRIPPER. Casto, M. G.; Hoh, Y. C.; Smutz, M.; Bautista, R. G. (Ames Lab., IA). Ind. Eng. Chem., Process Design Develop.; 12: 432-437(Oct 1973). (IS-2444).

A dynamic study of a 10-stage box-type mixer-settler extractor was made using the system 2.7 M rare earth chloride ($RECl_3$) – 0.5 M di(2-ethylhexyl) phosphoric acid (HDEHP) – 0.1 M hydrochloric acid. Once steady state was reached, intentional upsets of varying degree were made in the individual flow rates and interface positions to test their effect on the raffinate product concentration and on the operation of the mixer-settler. The $RECl_3$ (feed) flow rate was found the most important variable to be controlled followed in order of importance by the HCl flow rate (organic phase) and the settler interface positions. The dynamics of the stripping of HDEHP containing 1.5, 1.8, and 1.9 M rare earths with 4 M HCl showed that the pregnant HDEHP flow rate was the most important variable to be controlled in order to maintain steady state followed by the HCl flow rate and the settler interface positions. (auth)

15333 SEPARATION OF RARE-EARTH ELEMENTS FROM APATITE. Brunfelt, A. O. (Univ. of Oslo). Separ. Sci.; 8: No. 5, 623-625(1973).

It is possible to obtain an individual isolation of most of the rare earths in apatite directly by column extraction chromatography. The method was tested by using an ~20-mg example of apatite that had been irradiated for 1 day in a thermal neutron flux of 1×10^{12} $U/cm^2 \cdot sec$. The irradiated sample was dissolved in 0.5 ml of 15.6 μ HNO_3 and added directly on the top of the column which was preconditioned with 15.6 μ HNO_3. A drop-elution technique was used and the eluted drops were collected on a moving ribbon of aluminium. A Geiger–Mueller counter was used to measure the beta activity. Seven elements (Sm, Eu, Dy, Ho, Y, Yb, Lu) were separated. (LK)

15334 COMPLEXATION BEHAVIOR OF THE LANTHANIDE-IMINODIACETIC ACID SYSTEM AND ITS POSSIBLE APPLICATION TO THE SEPARATION OF LIGHT RARE EARTHS FROM TRANSPLUTONIUM ELEMENTS BY ION EXCHANGE. Delle Site, A.; Kappelmann, F. A. (Comitato Nazionale per l'Energie Nucleare, Casaccia, Italy). Inorg. Nucl. Chem. Lett.; 10: No. 1, 81-86(Jan 1974).

It is stated that in an earlier study of the complexing behavior of the Am-iminodiacetic acid system five complexes were observed in the pH range 3.5 to 9.5. In the present studies the complexing behavior of Sm with iminodiacetic acid was investigated and three complexes were found for this system. Distribution coefficients were also measured for three light rare earths (Eu, Ce and Pm) and for Am and Cm with respect to Dowex 50W-X12 resin in the presence of the complexing agent, together with the possibility of mutual separation. A low Am/Cm separation factor was obtained due to the similarity of their chemical behavior, but the results obtained for Ce, Pm, and Eu allow a prediction of a separation factor of about 2 for adjacent rare earths. Differences were found in the complexing behavior of iminodiacetic acid with light rare earths and the transplutonium elements, and these differences suggest possible application of competitive complexation to the separation of the two groups by ion exchange. (UK)

15335 FLASH-TUBE HODOSCOPE CHAMBERS. Conversi, M.; Brosco, G. (Univ., Rome). Annu. Rev. Nucl. Sci.; 23: 75-122(1973).

Topics discussed include general properties of electrodeless flash tubes, theory of flash-tube operation, and large flash-tube installations and special hodoscope chambers. (TFD)

15336 CHERENKOV COUNTER TECHNIQUE IN HIGH-ENERGY PHYSICS. Litt, J.; Meunier, R. (CERN, Geneva). Annu. Rev. Nucl. Sci.; 23: 1-43(1973).

Recent developments in Cherenkov counter techniques as applied to the physics research at high-energy accelerators are reviewed. Topics discussed include general problems associated with the detection of Cherenkov radiation, threshold Cherenkov counters, differential Cherenkov counters, comparisons of threshold and differential Cherenkov counters, and pattern recognition in a focusing Cherenkov counter. (TFD)

15337 SEPARATION OF RARE EARTHS BY EXTRACTION CHROMATOGRAPHY WITH DI(2-ETHYLHEXYL)PHOSPHORIC ACID. II. Behavior of the Matrix and Its Influence on the Behavior of Microcomponents. Herrmann, E. (Technische Univ., Dresden); Grosse-Ruyken, H.; Chalkin, W. J. Chromatogr.; 87: No. 2, 351-363(19 Dec 1973).

The use of extraction chromatography with undiluted di(2-ethylhexyl)phosphoric acid as the stationary phase for macro/micro separations of lanthanides has been studied. Macro amounts of a rare-earth element are retained on the column bed from weakly acidic solutions in the form of tris(dialkyl phosphates). By elution with diluted mineral acids an asymmetrical peak with a sharp front and a long tail is observed. The position A of the front, normalized to the unity di(2-ethylhexyl)phosphoric acid volume on the column, depends on the loading B (expressed in %) of the column with rare-earth ions and on the partition coefficient D for this element in tracer concentration. This dependence can be expressed by the following equation: $\log A = \log D - 0.036\ B - 0.15$. The influence of the macro amount of the given rare earth element on the behavior of the other lanthanides present in tracer concentration has also been investigated. When the micro element has a lower atomic number than the macro element and $A_{macro}/D_{micro} \geq 1.5$, it is pos-

sible to isolate the tracer with a yield of more than 80% and with an enrichment factor of about 10^6. But in this case the loading of the column should be no more than about 50% of the maximum column capacity. In the opposite case, when the tracer has the higher atomic number, the isolation process of micro elements is less sensitive to the macro amount. In some cases even the total column capacity could be used. But as a result of the tailing effects the enrichment factors are usually reduced to values of about 10^3–10^4. (auth)

15338 FORMATION CONSTANTS OF PROTONATED AND LANTHANON N′-METHYLETHYLENEDIAMINE-N,N,N′-TRIACETATE SPECIES. Powell, J. E.; Johnson, D. A.; Burkholder, H. R.; Vick, S. C. (Ames Lab., IA). J. Chromatogr.; 87: No. 2, 437–442(19 Dec 1973).

Formation constants of protonated and chelate species formed between hydrogen ion and rare-earth cations and the anion of the recently synthesized N′-methylethylenediamine-N,N,N′-triacetic acid were determined at an ionic strength of 0.100 M (KNO_3) and 25° by a potentiometric method. (auth)

15339 SEPARATION OF YTTRIUM AND DYSPROSIUM BY THERMAL DIFFUSION IN AQUEOUS SOLUTION. Erametsa, O.; Tassavainen, A. (Univ. of Helsinki). Acta Chem. Fenn.; 46: No. 4B, 121–127(1973).

An annular thermogravitational column (98 cm long; 10.9 cm OD; 0.112 cm diffusion spacing), heated internally and cooled externally by flowing water, was used to fractionate solution containing $Y_2(SO_4)_3$ (mm to 2 mm) and $Dy_2(SO_4)_3$ (0.3 to 4.5 mm) in dilution H_2SO_4. The extent of separation of Y from Dy ranged from 0.8 to 6.9%. Diffusion coefficients are calculated and two modes of operation (total-reflux and continuous) are discussed. (Anal. Abstr.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 15279 and 15321.

Chemical and Physicochemical Properties

Refer also to abstracts 15291, 15413, 16163, 16799, 16889, 17974, and 17975.

15340 (FRNC-TH-435) REDUCTION OF PENTAVALENT AMERICIUM BY HYDROGEN PEROXIDE IN PERCHLORIC SOLUTION. Damien, N. (Clermont-Ferrand Univ., 63 (France)). [nd]. 112p. (In French). Dep. NTIS (U. S. Sales Only) $7.75. Thesis.

The reduction of Am(V) by hydrogen peroxide in 0.2N, 0.6N, and 1N perchloric solution was studied. The effects of the following parameters on the speed of the reaction were studied: Am(V) concentration, hydrogen peroxide concentration, acidity of the solution, and its ionic strength. (FR)

15341 REACTION KINETICS IN SUB-MICRONIC POWDERS THE ZrO_2–CaO SYSTEM. Cismaru, D.; Radovici, C. (Centre of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 18: No. 10, 1699–1708(Oct 1973).

The kinetic study of the reaction ZrO_2 + CaO in mixtures of submicronic crystals in the temperature range 900 to 1150°C shows that the reaction takes place according to an equation of the Avrami–Erofeev type: $1 - z = \exp(-Kt^n)$ with $n < 1$, and the factor controlling the reaction rate is the formation of new germs. Between 900 and 1000°C, the activation energy was also determined at 53.9 kcal/mol. Over 1000°C the phase transitions influence considerably the reaction mechanism. (auth)

15342 REACTIONS OF THE OXIDES OF VANADIUM WITH LIQUID POTASSIUM. Barker, M. G.; Hooper, A. J.; Lintonbon, R. M. (Univ. of Manchester, Eng.). J. Chem. Soc., Dalton Trans.; No. 23, 2618–2620(1973).

The reactions of the oxides V_2O_5, V_2O_3, VO_2, and VO with liquid potassium were studied at temperatures up to 400°C. The oxides V_2O_5 and VO_2 react at 63°C (the mp of potassium); V_2O_3 at 180°C; and VO was found not to react at up to 400°C. The new compound KVO_2 was identified as the only reaction product of the dioxide VO_2 with liquid potassium. The pentoxide V_2O_5 and the oxide V_2O_3 gave the oxides VO and KVO_2 as reaction products, but both these compounds were found to oxidise to the ternary oxide K_3VO_4 in the presence of dissolved oxygen in the liquid metal. The behavior of liquid potassium towards the oxides of vanadium is compared with the other alkali metals, lithium and sodium. (auth)

15343 REACTIONS OF POTASSIUM MONOXIDE WITH THE OXIDES OF VANADIUM. Barker, M. G.; Hooper, A. J. (Univ. of Nottingham, Eng.). J. Chem. Soc., Dalton Trans.; No. 23, 2614–2617(1973).

The alkali-rich portion of the K_2O–V_2O_5 system was investigated by the reaction of various potassium oxo-compounds with vanadium pentoxide. The compounds KVO_3, $K_{32}V_{18}O_{81}$, $K_4V_2O_7$, and K_3VO_4 lose oxygen and three forms of the compound K_3VO_4 were established. Both oxidations and disproportionations were observed for the K_2O–VO_2 system, and a new compound KVO_2 was found in the reaction of equimolar mixtures of the monoxide K_2O and vanadium dioxide. The lower oxides of vanadium and vanadium metal were oxidized by potassium monoxide to the vanadate K_3VO_4. The reactions of potassium monoxide are compared with those of sodium oxide for the same stoichiometry. (auth)

15344 REACTIONS OF LIQUID SODIUM WITH TRANSITION METAL OXIDES. VII. The Oxides of Niobium and Tantalum. Barker, M. G.; Hooper, A. J.; Wood, D. J. (Univ. of Nottingham, Eng.). J. Chem. Soc., Dalton Trans.; No. 1, 55–58(1974).

The reactions of the oxides Nb_2O_5, NbO_2, NbO, and Ta_2O_5 with liquid sodium were studied at 400 and 600°C and the products examined by x-ray powder crystallography. In each case in which reaction took place, the equilibrium products were found to be the transition metal together with the cubic form of Na_3NbO_4 or Na_3TaO_4. The possible reaction mechanisms of the oxides in liquid sodium are discussed. The reactions of the ternary oxides $NaNbO_3$, $NaTaO_3$, Na_3NbO_4, Na_3TaO_4 with pure liquid sodium, and $NaTaO_3$ and Na_3TaO_4 with oxygen-doped liquid sodium, were all studied. (auth)

15345 HANDBOOK OF THE PHYSICOCHEMICAL PROPERTIES OF THE ELEMENTS. Samsonov, G. V. (ed.). New York; Plenum Publishing Corporation (1968). 951p. $29.50.

Translation of Fiziko-khimicheskie svoistva elementov.

This volume contains concise information on the basic physical properties of the elements and on their chemical characteristics. It provides tabulations of the atomic, crystallographic, nuclear, thermodynamic, thermal, electrical, magnetic, optical, mechanical, and electrochemical properties of the elements. (2598 references) (RWR)

Isotope Effects

Refer also to abstracts 15402, 15406, 15409, and 15410.

15346 KINETIC DEUTERIUM ISOTOPE AND ELECTRONIC EFFECTS IN THE SILVER(I) PROMOTED TYPE γ ISOMERIZATION OF 1-ALKYLTRICYCLO[4.1.0.$0^{2,7}$]HEPTANES. Mechanistic Analysis of the Formation of Bicyclo[3.2.0]hept-6-enes. Paquette, L. A.; Zon, G. (Ohio State Univ., Columbus). J. Amer. Chem. Soc.; 96: No. 1, 224–233(9 Jan 1974).

The Ag(I)-catalyzed isomerization of 1-carbomethoxytricyclo-[4.1.0.$0^{2,7}$]heptane follows second-order kinetics and proceeds (slowly) to give mainly 2-carbomethoxy-1,3-cycloheptadiene. The marked changeover in product distribution relative to related compounds with alkyl groups at C_1 is attributed to an electronic effect which operates however to decelerate chiefly the type γ rearrangement pathway. Deuterium isotope effects have been determined for syn-3-methoxy-1-methyltricyclo[4.1.0.$0^{2,7}$]heptane carrying isotopic label at C_2 and at C_7. In the latter instance, the formation of 6- and 7-methylbicycloheptenes is affected identically (k_H/k_D = 1.45). Deuterium substitution at C_2, in contrast, partitions the interaction mechanisms so as to enhance the production of the 6-methyl isomer (k_H/k_D = 0.87) and retard formation of the 7-methyl derivative (k_H/k_D = 1.17). These observations have been incorporated with previous results to provide detailed mechanistic interpretations of the generalized type α and γ rearrangements. (auth)

15347 MASS SPECTROSCOPIC DETERMINATION OF THE ISOTOPE EFFECT IN THE DIFFUSION OF MAGNESIUM IN SILVER. Kohl, J. G. Muenster, Ger.; Univ. Muenster (1972). 70p. (In German). Thesis.

The isotope effect in the diffusion of the stable magnesium isotopes ^{25}Mg and ^{26}Mg in silver was determined at a temperature of 812.5°C. The frequency ratio of the isotope was measured as a function of the penetration depth in the diffusion by means of mass spectrometric analysis. The diffusion of magnesium in silver in the α-mixed crystal region of the system Ag-Mg depends on concentration. The partial diffusion coefficient of magnesium could be determined for four concentration values. The ratio of the diffusion coefficients of magnesium to silver in infinite dilution is $D(Ag/Mg)^*_0/D(Ag/Mg)^*_0$ 3.91 at 812.5°C and 4.15 at 821°C respectively. A method was developed to evaluate the isotope effect from the diffusion process in the chemical concentration slope. From the relative change of the isotope frequency ratios of magnesium in the diffusion in silver, the isotope effect E = 0.08 was obtained. (GE)

15348 THEORETICAL ESTIMATION OF ISOTOPE EFFECTS IN MONOATOMIC GASES DISTRIBUTED IN SOLIDS. Parbuzin, V. S.; Malyavskii, N. I. Vestn. Mosk. Univ., Ser. II, Khim.; 14: No. 5, 568-570(1973). (In Russian).

The Poeschl-Teller (PT) model potential is suggested to describe the isotope effects in vapor pressure of occluded gases. Separation coefficients (α) in a wide temperature range and potential parameters (γ and ρ) are calculated for the isotopic pairs H-D, ^{3}He-^{4}He, and ^{20}Ne-^{22}Ne. The weak temperature dependence of α is found for the PT potential in comparison with the harmonic oscillator which makes it possible to use the systems for isotope separation at relatively high temperatures. (auth)

15349 ACTIVATION PARAMETERS FOR THE RESTRICTED ROTATION OF THE HYDROXYL GROUP IN THE DUROQUINOL CATION RADICAL AS DETERMINED FROM THE ELECTRON SPIN RESONANCE SPECTRA. Ondercin, D. G.; Sullivan, P. D. (Ohio Univ., Athens). J. Phys. Chem.; 78: No. 2, 130-134(17 Jan 1973).

The ESR spectra of the duroquinol and duroquinol-d_2 cation radicals have been reinvestigated in various oxidant-solvent systems. In contrast to previous work the isomer ratio at low temperatures is found to be 70 : 30 in favor of the trans form. Using a calculation based on density matrix theory and spectra have been simulated and matched throughout the temperature range studied and activation parameters have been obtained. The new value for the barrier to rotation of the hydroxyl proton in duroquinol is ca. 7 kcal/mol, this now compares favorably with the value obtained by considering only the temperature dependence of the hydroxyl proton splitting constant. The effect of solvent and deuterium substitution on the activation parameters is also discussed. (auth)

15350 INFRARED STUDIES OF APATITES. I. Vibrational Assignments For Calcium, Strontium, and Barium Hydroxyapatities Utilizing Isotopic Substitution. Fowler, B. O. (National Inst. of Dental Research, Bethesda, MD). Inorg. Chem.; 13: No. 1, 194-207(Jan 1974).

The infrared spectra of powdered calcium hydroxyapatite isotopically substituted with D, ^{18}O, ^{44}Ca, and ^{48}Ca and infrared spectra of powdered strontium and barium hydroxyapatites and their deuterated analogs are reported at 48 and -185° in the 4000-200-cm^{-1} region. Band assignments, based on isotopic frequency shifts, band intensity, band temperature dependency, and comparisons between corresponding bands of these structurally related apatites are presented for the above and other apatites. (auth)

15351 EQUILIBRIUM ISOTOPE EFFECTS. Bigeleisen, J.; Lee, M. W.; Mandel, F. (Univ. of Rochester, NY). Contract AT(11-1)-3498. Annu. Rev. Phys. Chem.; 24: 407-440(1973).

Significant theoretical and experimental advances during the past three years in the area of equilibrium isotope effects are reviewed. Section headings are: isotope separation; chemical exchange equilibria: theory; calculations of reduced partition function ratios; chemical exchange equilibria: experimental; solvent isotope effects; isotope effects in phase equilibria; and physical properties of a substance upon isotopic substitution, including heat capacity, phase transitions, superconductivity, and crystalline structure. (248 references) (auth)

15352 Q BRANCH OF THE FUNDAMENTAL RAMAN BAND OF THE ORDERED PHASE OF SOLID HYDROGEN AND DEUTERIUM. Prior, W. R. C.; Allin, E. J. (Univ. of Toronto). Can. J. Phys.; 51: No. 18, 1935-1943(15 Sep 1973).

The Raman transition $v = 0 \rightarrow v = 1$, $J \rightarrow J$ has been studied in the ordered phase of solid o-H_2 containing ~5% p-H_2, and of solid p-D_2 containing ~5% o-D_2. Two new features of low intensity appear in the Q branch when the change from the disordered to the ordered structure occurs. One of the new features is sharp and is due to a vibrational excitation which is localized because, when the concentration of impurity molecules is low, the ordering of the molecules is distorted only locally about the impurity sites. The second new feature is broad and is due to simultaneous vibron-libron excitations. The frequency of the intense $Q_1(1)$ feature decreases by ~0.5 cm^{-1} on ordering due to an increase in the quadrupolar intermolecular interaction in the ordered phase; the $Q_1(0)$ feature is unaffected by the ordering. (auth)

15353 HYDROGEN-BOND STUDIES OF THE NEAR INFRARED COMBINATION BANDS OF THE BUTYLAMINES. Sinsheimer, J. E.; Keuhnelian, A. M. (Univ. of Michigan, Ann Arbor). Anal. Chem.; 46: No. 1, 89-93(Jan 1974).

Deuteration, concentration, and temperature studies are employed to establish the 1.99-μm band of primary butylamines to be free N-H absorption and the 2.02-μm band to be hydrogen-bonded N-H absorption. The effect of amine structure on absorptivity of these bands is noted and correlation of Taft $+\sigma^*$ values to the 2.02-μm absorbance observed. The absorbance at 2.02 μm is also correlated to solvent-solute hydrogen bonding. The interrelationships of concentration, amine structure, and solvent-solute hydrogen bonding as to their effects on the 1.99- and 2.02-μm combination bands of primary butylamines are discussed. (auth)

15354 VIBRATIONAL SPECTRA AND STRUCTURE OF SOME PENICILLIN DERIVATIVES. Part III. Amphicillin and Carboxybenzylpenicillin. Dziegielewski, J.; Hanuza, J.; Jezowska-Trzebiatowska, B.; Kuduk-Jaworska, J. (Joliot-Curie Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 9, 657-668 (1973).

IR spectra of sodium salts and acids of amphicillin and carboxybenzlpenicillin were investigated in the solid state over the 400-200 cm^{-1} region. Interpretation of the spectra and band assignments was made on the basis of both frequency shifts caused by deuteration and the information on penicillin-like antibiotics from previous studies. The molecular configuration of such a type of antibiotics was suggested, based on the position of characteristic amide and carbonyl bands. Lactam-thiazolidine skeleton vibrations are identified and located. The information obtained will be used in studies on ir spectra of the γ radiolysis products resulting from lactam-thiazolidine antibiotics to define the radiolysis products and the mechanism of decomposition. (auth)

15355 FUNCTIONAL GROUP TRANSFORMATIONS IN THE GAS CHROMATOGRAPHIC DERIVATIZATION OF SEVERAL CARBAMATES AND URETHANES. Vandenheuvel, W. J. A.; Gruber, V. B.; Walker, R. W. (Merck Sharp and Dohme Research Labs., Rahway, NJ). J. Chromatogr.; 87: No. 2, 341-351(19 Dec 1973).

Heptafluorobutyrylation and trimethylsilylation have been found with several carbamates and urethanes to result in the formation of unexpected products. Among the functional group transformations are conversions to the corresponding heptafluorobutyramide and trimethylsilyl ether. An on-column conversion of a trimethylsilylated carbamate to the corresponding isocyanate has been studied with respect to rate of trimethylsilylation and column temperature. By judicious choice of conditions the carbamate, its trimethylsilyl derivative, and the corresponding isocyanate can be chromatographed, allowing for an additional dimension of selective detection with a mass spectrometer. (auth)

15356 CATALYSIS BY REVERSED MICELLES IN NONPOLAR SOLVENTS. Trans-Cis Isomerization of Bis(Oxalato)Diaquochromate(III). O'Connor, C. J.; Fendler, E. J.; Fendler, J. H. (Texas A and M Univ., College Station). J. Amer. Chem. Soc.; 96: No. 2, 370-375(23 Jan 1974).

Rate constants for the trans-cis isomerization of bis(oxalato)-diaquochromate(III) anion in the polar cavities of reversed alkylammonium carboxylate micelles in benzene are up to 63-fold faster than that in pure water. At constant water concentrations increasing concentration of the surfactants increases the rate to a maximum after which it remains constant. Similarly, at constant surfactant concentrations, at the plateau region, increasing water concentration increases the rate to a maximum after which it remains constant. The rate constant in the presence of 1.0×10^{-2} M D_2O solubilized in >0.1 M DAP-(N)d_3 in benzene at 24.5° (k_ψ = 11.3×10^{-3} sec^{-1}) is a factor of 2.99 greater than that in the presence of 1.1×10^{-2} M H_2O solubilized in >0.1 M DAP (k_ψ = 3.85×10^{-3} sec^{-1}). The observed isotope effect depends on the concentration of solubilized water. At high water concentration $k_\psi^{D_2O}/k_\psi^{H_2O}$ decreases to 1.16. These results are discussed in terms of solubilization of the substrate in the polar cavity of the reversed micelle where isomerization follows a mechanism which involves water in a rate-determining step. Linear dependencies have been observed between the logarithm of the rate constants for the trans-cis isomerization the the pK differences between the amines and carboxylic acids for two series of alkylammonium carboxylate surfactants. (auth)

15357 PHOTOCHEMISTRY OF α-CYCLOALKOXYACETOPHENONES. Type II and Vibronic Pathways for Radiationless Triplet Decay. Darling, T. R. (Columbia Univ., New York); Turro, N. J.; Hirsch, R. H.; Lewis, F. D. J. Amer. Chem. Soc.; 96: No. 2, 434-439(23 Jan 1974).

Medium and small ring α-cycloalkoxyacetophenones other than α-cyclopropoxyacetophenones undergo normal photochemical type II reactions with high efficiency. The products obtained are a novel family of 1-oxaspiro[3.n]alkanes as well as the corresponding cycloalkanones. The photochemical behavior of α-cyclopropoxyacetophenones deviates markedly from that of their higher homologs and is characterized by: (1) low efficiency of product formation, (2) unprecedented cis-trans isomerization of the cyclopropane ring for the α-(2,3-dimethylcyclopropoxy)acetophenones, and (3) triplet lifetimes which are shortened by remote ring methyl substitution. Replacement of the γ hydrogen with deuterium increases the triplet lifetime and the quantum yields for the type II and ring isomerization processes. Both the ring isomerization and the

rapid radiationless decay of the triplet state are attributed to vibronic energy transfer between the excited carbonyl chromophore and the γ hydrogen-cyclopropyl unit. (auth)

15358 THERMAL π-ROUTE REARRANGEMENT OF 4-CYCLOHEPTENE-1-METHYL ACETATE. Thies, R. W.; Schick, L. E. (Oregon State Univ., Corvallis). J. Amer. Chem. Soc.; 96: No. 2, 456-460(23 Jan 1974).

Pyrolysis of 4-cycloheptene-1-methyl acetate under flow conditions gives only rearranged acetates and rearranged hydrocarbons whereas static conditions lead only to a simple elimination product and its Cope rearrangement isomer. The rearranged bicyclic acetates formed under flow conditions are strikingly similar to those of π-route solvolysis of the corresponding brosylate. The reaction rates under flow conditions were sensitive to conditioning of the reactor with allyl bromide. (auth)

15359 MECHANISM OF OZONOLYSIS. (A) Microwave Spectra, Structures, and Dipole Moments of Propylene and Trans-2-Butene Ozonides. (B) Orbital Symmetry Analysis. Lattimer, R. P.; Kuczkowski, R. L.; Gillies, C. W. (Univ. of Michigan, Ann Arbor). J. Amer. Chem. Soc.; 96: No. 2, 348-358(23 Jan 1974).

The microwave spectra of 11 isotopic species of propylene ozonide and the normal isotopic species of trans-2-butene were assigned. Both compounds were found to have an oxygen–oxygen half-chair conformation with equatorial methyl groups. No effects from pseudorotation or internal rotation were observed. The detailed structure of propylene ozonide was determined. The dipole moments of both compounds were measured. The cis–trans ratio of 2-butene ozonide obtained as a cross ozonide from propylene was found to be 81 : 19 in contrast to the ~40 : 60 ratio obtained from 2-butene. The syn-anti zwitterion mechanism for ozonolysis was reviewed; a mechanistic scheme consistent with orbital symmetry arguments was presented to elucidate the pathway of syn-anti zwitterion formation and the formation of cis and trans final ozonides. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 15560 and 16090.

15360 Pt(II)-CATALYSED $^1H-^2H$ EXCHANGE IN ALKANES AND CYCLOALKANES. Littlecott, G. W.; McQuillin, F. J. (Univ. of New Castle Upon Tyne, Eng.). Tetrahedron Lett.; No. 50, 5013-5016(Dec 1973).

Gol'dshleyer et al. [Zhur. fiz. Khim. 43, 2174 (1969) and Abs. Intern. Conf. Organometallic Chem., Moscow, 1971,328] proposed a reaction scheme for $^1H—^2H$ exchange of alkanes catalyzed by Pt(II) chloride in AcOD and D_2O. This included a Pt-alkene complex. Hodges et al. [J. Chem. Soc. (A); 3230 (1971)] outlined an alternative which omitted the Pt-alkene complex and involved an initial alkane to platinum electron transfer. The exchange was examined further in a series of experiments reported here. Conclusions are drawn about possible reaction mechanisms, in the light of the previous proposals. (UK)

15361 RUTHENIUM-CATALYZED HYDROGEN–DEUTERIUM EXCHANGE IN ALCOHOLS. A Convenient Method for Deuterium Labeling Of Primary Alcohols. Regen, S. L. (Marquette Univ., Milwaukee). J. Org. Chem.; 39: No. 2, 260-261(25 Jan 1974).

Deuteration of primary alcohols in the C-1 position can be accomplished by adding deuterium oxide to a mixture of ruthenium catalyst and any one of the primary alcohols tested. The advantages of this procedure lie in its simplicity, its low cost, its avoidance of reactive oxidants and reductants, and its ability to be carried out under neutral pH. (LK)

15362 REACTIONS CATALYZED BY $Co_2(CO)_8$. Selective Deuterium Incorporation into Some Polycyclic Hydrocarbons. Weil, T. A. (Univ. of Chicago); Friedman, S.; Wender, I. J. Org. Chem.; 39: No. 1, 48-50(11 Jan 1974).

Anthracene and anthraquinone can be converted to 9,9,10,10-tetradeuterio-9,10-dihydroanthracene in the presence of excess D_2 (or D_2O), CO, and catalytic amounts of $Co_2(CO)_8$. Pyrene also undergoes reduction and H–D exchange at the 4 and 5 positions; phenanthrene fails to react. When 1-octene is treated with CO and $Co_2(CO)_8$ in the presence of the tetradeuteriodihydroanthracene, as a deuterium source, C_9 aldehydes, randomly substituted with deuterium, result. (auth)

15363 MODEL FOR THE PROTON TRANSFER STAGES OF THE BIOLOGICAL TRANSAMINATIONS AND ISOTOPIC EXCHANGE REACTIONS OF AMINO ACIDS. Broadhurst, M. D.; Cram, D. J. (Univ. of California, Los Angeles). J. Amer. Chem. Soc.; 96: No. 2, 581-583(23 Jan 1974).

The biological and model systems both possess a stereospecific and intramolecular pathway for a suprafacial 1,3-proton transfer across an aza-allylic anion. Both possess a stereospecific pathway for an isotopic exchange reaction (retention of configuration) between the α hydrogen of a derivative of an amino acid and the medium. The model differs from the biological system by providing competing stereochemical and isotope-labeling reaction pathways. (LK)

Feed Materials Processing

Refer also to abstracts 15424, 15546, and 16066.

15364 (INIS-mf-944) SOME ASPECTS OF ^{212}Pb AND ^{232}Th AIRBORNE CONTAMINATION IN A MONAZITE ORE MILL. Figueiredo, N. (Rio de Janeiro Univ. (Brazil). Instituto de Biofisica). 1972. 70p. (In Portuguese). INIS.

Thesis.

Sampling for measurements of airborne radioactivity is performed to assess the possible radiation hazards associated with the ore processing. Since the major contaminant (^{220}Rn) has a short half-life (54 s), the degree of radioactive contamination in the working atmosphere is determined through measurement of airborne ^{212}Pb, which is the ^{220}Rn decay product with the longest half-life (10.64 h). High volume air samplers (Staplex) and Whatman-41 filter paper are employed to collect airborne particles and the total alpha activity is determined for all samples by means of the ZnS(Ag) scintillator method. Long-lived activity on the filters is found to be due to finely divided monazite particles. Highest levels of ^{212}Pb and monazite particles in the atmosphere are found in chemical and physical treatment areas of the plant, respectively. (INIS)

15365 (JEN-276) STATIC LEACHING OF URANIFEROUS SHALES WITH COUNTERCURRENT CIRCUITS. Cordero, G.; Villarrubia, M.; Hernandez, J. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 32p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.75.

Different amounts of acid and the method of addition were tested for solubilizing uranium in static leaching. The effects of temperature were tested. Solvent extraction tests were included and the most important variables considered. In order to get uranium solubilizations >80%, it is necessary to work with 32 kg per ton of acid for 40 days. The pregnant liquors have a high concentration of silica, necessitating the use of a low organic liquid (≤3.5% in amine); the acidity of the pregnant solution is adjusted to 4-8 g H_2SO_4/liter. The economics of the process is discussed. (LK)

Radiation Chemistry

Refer also to abstracts 15321, 15354, 15405, 15430, 15825, 15826, 15831, 15832, 15862, 15876, 15877, 15879, 15886, 15889, and 16370.

15366 (AEC-tr-7226/3-4) NUKLEONIKA. Translation of Nukleonika; 17: No. 3-4, 145-258(1972). 100p. (TT-54027/3-4). Dep. NTIS $5.45.

15367 (COO-2026-14) STUDIES IN CHEMICAL REACTIVITY. Progress Report, January 1, 1973–December 31, 1973. Carr, R. W. Jr. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1973. Contract AT(11-1)-2026. 11p. Dep. NTIS $3.00.

The kinetics of the reaction of hydroxyl radicals with C_2H_2, C_2H_4, C_3H_6, 1-C_4H_8 and cis-2-C_4H_8 were studied in a tubular discharge-flow reactor. The rate of the reaction OH + OH → H_2O + O was also investigated in the same reactor. Measurements of the pressure dependence of the relative yields of CH_2 ($^1A_1$) and CH_2 ($^3B_1$) were extended to pressures ranging downward from 10 torr to 0.1 torr. Preliminary experiments on some reactions of methylene, hydroxyl, HNO and O(^1D) have been done by flash photolysis with time-resolved mass spectrometry. Experiments on CH_2CO photolysis in the presence of cis 2-butene in the 2500–3100 Å region have been done, and the results are being examined for evidence of CH_2 ($^1B_1$) production. Construction of an apparatus for flash spectroscopy was started. Work on collisional deactivation of chemically activated polyatomic molecules has commenced with some experiments on methylcyclopropane. Numerical analysis of HNO decay rates, obtained by flash spectroscopy, was done, and transition state theory was applied to the reaction 2 HNO → N_2O + H_2O. (auth)

15368 (FRNC-TH-403) STUDY OF THE FORMATION OF IODIDES IN SOLID PENTANE AND BENZENE IRRADIATED WITH I^+ AND I_2^+ IONS. Akcay, H. (Strasbourg-1 Univ., 67 (France)). 1973. 94p. (In French). Dep. NTIS (U. S. Sales Only) $6.75.

Thesis.

The formation of organic iodides in solid hydrocarbon targets bombarded with 2-keV to 10-eV $^{127}I^+$ and $^{127}I_2^+$ ions at liquid nitrogen temperature was studied. Normal pentane and benzene, substances having very different behaviors under irradiation, were investigated. Various radicals were produced in the pentane. When energies in excess of a few hundred eV are used, the type of fragmentation is not very dependent on the binding energy. On the other hand, at low energies, the weakest C–H bonds are preferentially broken. In the case of C_6H_6, the breaking of the benzene ring is not a very frequently occurring event and the only radicals produced are phenyl radicals. In the case of pentane, radiolysis of the medium under the effect of radiations associated with nuclear transformations, and in particular radiolysis due to Auger electrons, only contributes slightly to the organic iodide yields. In contrast, the intervening of Auger electrons is essential in the explanation of the high yields of iodobenzene observed as a result of a nuclear transformation leading to an internal electron vacancy. (FR)

15369 POLY(VINYL ALCOHOL) HYDROGELS. Formation by Electron Beam Irradiation of Aqueous Solutions and Subsequent Crystallization. Bray, J. C.; Merrill, E. W. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Polym. Sci.; 17: No. 12, 3779–3794(Dec 1973).

Aqueous solutions of poly(vinyl alcohol) were submitted to varying doses of electron beam irradiation. By modification of the classical Flory–Huggins equations, the molecular weight between crosslinks was calculated as a function of radiation dose, initial polymer concentration, and temperature. Following crosslinking in the solution state, crystallization was induced by dehydrating the network at temperatures above 90°C. Following dehydration, the polymer network was reequilibrated with water and its tensile properties compared with identically prepared hydrogels not subjected to crystallization by dehydration. Greatly enhanced values of ultimate tensile strength and resistance to tear result from the treatment producing crystallization, compared with those of the crosslinked but not previously dehydrated gels. (11 figures, 23 references) (auth)

15370 IDENTIFICATION OF PRODUCTS FORMED BY RADIOINDUCED OXIDATION OF 3-PICOLINE. Onopko, T. V.; Saraeva, V. V. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 5, 619-621(1973). (In Russian).

Polarography and ultraviolet spectroscopy were used for identification of products formed under radiation-induced oxidation of 3-picoline. Both 3-pyridylaldehyde and 3-picoline hydroperoxide were identified. (auth)

15371 KINETIC STUDIES OF IONIC AND RADICAL PROCESSES IN SOLUTIONS OF γ-IRRADIATED CYCLOHEXANE AND NEOPENTANE. Jungbluth, U. Berlin; Technische Univ., Berlin (1972). 77p. (In German).

Thesis.

Ethyl chloride was identified as a specific scavenger for electrons in cyclohexane in the radiolysis of hydrocarbons. The reactivity of the C_2H_5Cl compared to electrons was found to be α = 0.9 l/Mol, lower than for CH_2Br, -Cl, EtBr, $PhCH_2Cl$. For solution with yet a second scavenger, (CH_2Br, CH_2Cl) besides EtCl, the same laws of inhomogeneous kinetics are valid for the total yield of scavenger electrons as for the reaction $e^- + C_2H_5Cl$. For the solution of EtCl and CH_2Br or EtCl and CH_2Cl, the CH_2-radical yields from the dissociative electron scavenging are greater and the C_2H_5 radical yields are correspondingly smaller as is to be expected from the reactivities. An electron transfer from primary formed and relatively long-lived $C_2H_5Cl^-$ ions to CH_2Cl or CH_2Br is assumed. For neopentane (inhomogeneous kinetics), the values $\alpha_{(CH_2Br)}$ = 6 l/mol, $\alpha_{(C_2H_5Br)}$ = 1 l/Mol have been found, the total yield of electrons was about G = 5.2, the yield of free ions $G_{(fi)}$ = 0.8, a high yield of methyl radicals, the yield of free H atoms was found to be G = 1.2 by scavenging with ethylene, here homogeneous kinetics are valid. The rate constants for H x + neo-C_5H_{12} to H x + C_2H_4 are of the ratio K_1/K_2 = 0.0026. The C-C bond in the irradiation of C_2H_5I is practically not attacked. (GE)

15372 USE OF TETRAPHENYLHYDRAZINE AS AN ACCEPTOR OF EXCITATION OCCURRING IN RADIOLYSIS OF SOLID ORGANIC SOLUTIONS. Ershov, B. G. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 2, 372-375(11 Jul 1973). (In Russian).

Tetraphenylhydrazine (TPH) was shown to be usable as an acceptor of the excitation generated by low-temperature radiolysis (^{60}Co gamma radiation) of organic substances. The efficiency of formation of radical pairs in TFH solutions in various solvents was related to the processes that resulted in singlet and triplet excitation generation and the effectiveness of their transfer. Determination of the radiation pair yield in gamma irradiation at 77°K of TPH in various solvents showed high G values for radical pair formation in aromatic solvents and ketones and low values in saturated nonpolar solvents except methylcyclohexane. (TTT)

15373 EFFECT OF ACID ON THE RADIOINDUCED COPOLYMERIZATION OF MONOMERS TO CELLULOSE. Dilie, S.; Garnett, J. L.; Phuoc, D. H. (Univ. of New South Wales, Kensington, Australia). J. Polym. Sci., Polym. Lett. Ed.; 11: No. 11, 711-715 (Nov 1973).

The effect of sulfuric acid on the radioinduced copolymerization of styrene solution in methanol to cellulose was studied. The Trommodorff effect occurs at approximately 30% vol/vol styrene in methanol for cellulose. The position of the peak varies with the structure of monomer and solvent; while the magnitude of the effect is also dose and dose-rate dependent. (LK)

15374 PULSE RADIOLYSIS STUDIES OF NITROFURANS: Chemical Radiosensitization. Greenstock, C. L.; Dunlop, I. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Radiat. Res.; 56: No. 3, 428-440(Dec 1973).

The nitrofurans, which radiosensitize anoxic mammalian cells to the same degree as oxygen, were studied by pulse radiolysis. Nifuroxime, a colorless nitrofuran derivative, reacts rapidly in aqueous solution with both the primary species (e_{aq}^-, OH, H) and with free radicals and radical anions of nucleic acid components, amino acids and other biochemical substrates. The biochemical free radicals react with nifuroxime either by electron transfer oxidation or by radical-adduct formation. The rate constants for both types of reaction, and their respective efficiencies, have been determined by monitoring the yield and kinetics of formation of the nifuroxime electron-adduct absorption in the presence of different concentrations of various biochemical substrates. The electron-adducts of purines, pyrimidines and amino acids transfer electrons to nifuroxime at diffusion-controlled rates. Their corresponding neutral free radicals transfer electrons, an order of magnitude more slowly, in competition with radical-nifuroxime addition reactions which have rate constants ~10^9 M^{-1} sec^{-1}. Electron transfer from the electron-adducts of less electron-affinic cellular radiosensitizers to nifuroxime and from nifuroxime to oxygen and other compounds of higher electron-affinity have also been observed. The relevance of these studies to mechanisms of chemical radiosensitization is discussed. (auth)

15375 ION-CLUSTERING OF THE CATIONS IN THE HIGH ENERGY IRRADIATION OF NITROUS OXIDE. Sieck, L. W. (National Bureau of Standards, Washington, DC); Gorden, R. Jr.; Ausloos, P.; Lias, S. G.; Field, F. Radiat. Res.; 56: No. 3, 441-459(Dec 1973).

The reactions of the positive ions in N_2O were studied mass spectrometrically at pressures up to approximately 2 Torr and at temperatures in the vicinity of 300°K, that is, under conditions similar to those which prevail in a gas-phase radiolysis experiment. The N_2O^+ parent ion associates with a N_2O molecule to form a $(N_2O)_2^+$ dimer, with a termolecular rate constant of 4.8 ± 0.5 × 10^{-28} cm^6/molecule^2-sec at 300°K. The ratio $(N_2O)_2^+/N_2O^+$ shows a sharp decrease with an increase in temperature. The NO^+ fragment ion also associates with a N_2O molecule to form the $NO^+ \cdot N_2O$ association ion. At pressures greater than 1 Torr, this ion associates with a second molecule of N_2O to form $NO^+ \cdot (N_2O)_2$. In order to investigate the effects of accumulated radiolytic products on the ionic mechanisms in N_2O, experiments were performed in which small amounts (~0.1%) of O_2, NO, and N_2 were added to N_2O. In the presence of 0.1% O_2, $O_2^+ \cdot N_2O$ is formed. In the presence of 0.1% NO, $NO^+ \cdot N_2O$ and $(N_2O)_2NO^+$ were observed in much greater abundance than in pure N_2O, presumably from a reaction of N_2O^+ or $(N_2O)_2^+$ with NO molecules. The $(NO)_2^+$ dimer ion was also observed in these experiments. No reactions of the positive ions in N_2O with N_2 were observed. The results obtained in earlier pulse radiolysis and conventional low dose rate radiolysis experiments are reevaluated in order to take into account the formation of association ions. If one assumes that no dissociation occurs in the N_2O species formed by neutralization of $(N_2O)_n^+$ ions by SF_6^-, it can be shown that observed pulse radiolysis results are consistent with the electron neutralization of $(N_2O)_n^+$ to give only one excited N_2O^* species which dissociates; an alternate assumption about the neutralization mechanism involving SF_6^- leads to the conclusion that, on the average, 1.8 N_2O species dissociate for each $(N_2O)_n^+$ ion neutralized by an electron. In the low dose rate radiolysis, accumulated products may be expected to modify the ionic mechanism, so that radiolytic product yields will be dependent on dose. (auth)

15376 PULSE RADIOLYTIC POLAROGRAPHY. Competitive Oxidation and Reduction of Hydroxycyclohexadienyl Radicals at the Mercury Drop Electrode in Aqueous Solutions. Bansal, K. M.; Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). J. Phys. Chem.; 78: No. 2, 160-164(17 Jan 1973).

Hydroxycyclohexadienyl radicals are produced in the pulse irradiation of aqueous N_2O-saturated solutions of aromatic compounds by a 20-nsec pulse of high-energy electrons in the vicinity of a handing mercury drop electrode. The polarographic current is recorded as a function of time and at constant potential. Simultaneously, the changes in the optical absorption of the radicals with time in the bulk of solution are measured. Short-time polarograms of radicals are obtained by plotting the current at about 20 μsec after the pulse vs. the electrode potential. Many hydroxycyclohexadienyl radicals show a steep polarographic wave with an anodic part immediately followed by a cathodic part. These waves are interpreted in terms of competitive oxidation and reduction of radicals. In addition, the problem of disproportionation of hydroxycyclohexadienyl radicals via electron transfer is discussed. Both electrode processes can occur with large rate constants in a certain potential range. Shifts of the waves to more negative potentials in the case of phenol and cresol are explained by the existence of mesomeric structures of α-alcohol radicals in the dihydroxycyclohexadienyl radicals formed. In strongly alkaline solutions, O^- reacts with toluene and benzylalcohol to form the benzyl radical and the benzyl alcohol radical anion, respectively. The polarograms of these radicals have well separated anodic and cathodic waves. The current vs. time curve of some radicals show a change in the sign of the current signal at potentials close to the foot of the polarographic wave. This effect is attributed to temporary changes in the relative concentrations of adsorbed and mobile radicals in the vicinity of the mercury drop electrode. (auth)

15377 LUMINESCENCE DECAY OF HYDROPHOBIC MOLECULES SOLUBILIZED IN AQUEOUS MICELLAR SYSTEMS. A Kinetic Model. Infelta, P. P.; Graetzel, M.; Thomas, J. K. (Univ. of Notre Dame, IN). J. Phys. Chem.; 78: No. 2, 190-195 (17 Jan 1973).

A phenomenological model describing the kinetics of quenching reactions in micelles is presented. Its validity is tested by laser photolysis experiments with aqueous solutions containing micellized sodium lauryl sulfate (NaLS) solubilized pyrene as a fluorescent probe and methylene iodide or nitromethane as quenchers. The constants of the distribution equilibrium of these quenchers between NaLS micelles and water were determined as $K(CH_3NO_2) = 1.64 \times 10^2\ M^{-1}$ and $K(CH_2I_2) = 2.5 \times 10^3\ M^{-1}$ (296°K) using the pulse radiolysis method. From the kinetic evaluation we obtain for the specific rates of association and dissociation of methylene iodide and NaLS micelles $n = 2.5 \times 10^{10}\ M^{-1}\ sec^{-1}$ and $k' = 9.5 \times 10^6\ sec^{-1}$ (296°K). Triplet lifetime measurements with solutions containing micellized cetyltrimethylammonium bromide (CTAB), anthracene, and Cu^{2+} ions show that the rate constant for the exit of anthracene from the CTAB micelle into the aqueous phase is as low as $2 \times 10^2\ sec^{-1}$ (296°K). (auth)

15378 EQUILIBRIA BETWEEN TRIPLET STATES OF AROMATIC HYDROCARBONS. Kira, A.; Thomas, J. K. (Univ. of Notre Dame, IN). J. Phys. Chem.; 78: No. 2, 196-199(17 Jan 1973).

An equilibrium between triplet states, $D^T + A \rightleftharpoons D + A^T$, was directly observed by pulse radiolysis and laser photolysis techniques. It was demonstrated that the free-energy difference calculated from the equilibrium constant is equivalent to the difference in energy between the triplet states. The triplet energy of a solute can be determined by measuring the equilibrium between the triplet state of this solute and another triplet of known energy. Triplet energies thus obtained are (in eV) biphenyl, 2.93, m-terphenyl, 2.88, and p-terphenyl, 2.66 which are higher than the phosphorescence energies and 1,1'-binaphthyl, 2.53 and 1,2'-binaphthyl, 2.43 which agree with the phosphorescence energies. The triplet energy obtained by this method is considered to correspond to the nonvertical triplet energy. (auth)

15379 EXCITED STATE PRODUCTION BY NONIONIC PROCESSES IN THE PULSE RADIOLYSIS OF GASEOUS SYSTEMS CONTAINING NAPHTHALENE. Sauer, M. C. Jr.; Mulac, W. A. (Argonne National Lab., IL). J. Phys. Chem.; 78: No. 1, 22-27 (3 Jan 1974).

The emission yield (relative) from the first excited singlet state of naphthalene and the yield of the lowest triplet state of naphthalene have been determined in the gas phase as a function of the concentrations of naphthalene, argon, and n-hexane in samples containing SF_6, which is known to eliminate the formation of these excited states by ionic processes. The conclusion is reached that in argon systems, an important mechanism for production of the lowest excited singlet of naphthalene is direct excitation by low-energy electrons which lose energy to argon with a much lower efficiency than to naphthalene. In n-hexane systems, the results indicate that a major part of the singlet emission is a result of energy transfer from an excited state of n-hexane. In the case of the triplet state yields, arguments are presented which indicate that intersystem crossing from a highly vibrationally excited level of the first excited singlet is responsible for a large part of the triplet yield, and that this cross over occurs before vibrational deactivation can occur, even at the relatively high pressures used. (auth)

15380 RADIOLYSIS OF LIQUID NITROUS OXIDE. Sambrook, T. E. M.; Freeman, G. R. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 78: No. 1, 28-31(3 Jan 1974).

The product yields from the γ radiolysis of liquid nitrous oxide at 183°K were $G(N_2) = 13.1 \pm 0.2$, $G(O_2)$ 2.7 ± 0.1, and $G(NO_2) = 5.6 \pm 0.2$. Addition of nitrogen dioxide (dinitrogen tetroxide) to the liquid decreased the oxygen yield to zero and the nitrogen yield to an extrapolated limit of 5 ± 1 units. Nitrogen dioxide scavenges electrons and probably positive charge and oxygen atoms in liquid nitrous oxide. Carbon dioxide has no effect on the product yields from nitrous oxide. Sulfur hexafluoride decreases the oxygen yield to zero and the nitrogen yield to 10 ± 1 units. Sulfur hexafluoride scavenges electrons and possibly oxygen atoms in liquid nitrous oxide. (auth)

15381 RADIOLYSIS OF LIQUID NITROUS OXIDE. Hydrocarbon Additives. Sambrook, T. E. M.; Freeman, G. R. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 78: No. 1, 32-37(3 Jan 1974).

Sixteen different hydrocarbons were added over wide concentration ranges to liquid nitrous oxide at 183°K. The oxygen and nitrogen dioxide yields were reduced from their initial G values of 2.7 and 5.6, respectively, to zero by 8 mol % hydrocarbon, while the water yield increased from zero to a maximum value of 11. The nitrogen yield decreased from 13.1 to about 11 over the same concentration region, but continued to decrease as the nitrous oxide was progressively diluted by the hydrocarbon. Kinetic analysis of the results led to the following observations. (a) G(total ionization) = 5.5 ± 0.5 in liquid nitrous oxide, nearly double the gas-phase yield. (b) Reactions of the charged species are precursors of all the NO_2 and 8 ± 1 G units of N_2. (c) The G value of N_2O^* formed by direct excitation is 5 ± 1, and the decomposition of N_2O^* is not inhibited by hydrocarbons. (d) Hydrocarbons inhibit nitrogen formation by reaction with N_2O^+, probably by charge transfer. (auth)

15382 SPIN TRAPPING OF HYDROGEN ATOMS IN γ-IRRADIATED LIQUID ALKANES. Mao, S. W.; Kevan, L. (Wayne State Univ., Detroit). J. Phys. Chem.; 78: No. 1, 91-92(3 Jan 1974).

The indirect observation of thermal H atoms in several organic liquids, including alkanes, by a spin trapping technique is reported. Spin trapping involves the addition of a short-lived free radical to a nitroso or nitrone function to form a stable spin adduct nitroxide that can be observed by epr to identify the original radical. (LK)

15383 RADIOLYSIS OF LIQUID HYDROCARBON–NITROUS OXIDE SOLUTIONS. The Precursors of Nitrogen. Freeman, G. R.; Sambrook, T. E. M. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 78: No. 2, 102-105(17 Jan 1973).

When nitrous oxide is added to liquid alkanes, the yield of nitrogen $g(N_2)_{HC}$ that results from energy initially absorbed in the hydrocarbon increases to a plateau value when the nitrous oxide concentration is increased. The plateau value $g(N_2)_{HC} = 5.2 \pm 0.2$ has been observed to extend over a 40-fold range of concentration in liquid ethane. The same plateau value has been observed in propane, extending over a fivefold concentration range. Similar plateaus exist in cyclohexane and methylcyclopentane, and appear also to exist in cyclopropane and neopentane. Secondary reactions involving oxygen-containing anionic intermediates do not form nitrogen in these solutions. Nitrogen results from the reaction of nitrous oxide with primary radiolytic species. The primary species appear to be mainly electrons, but a small contribution from neutral excited molecules cannot be excluded. The yield of primary species that react with nitrous oxide to form nitrogen is $g(\text{primary species})_{HC} = 5.2 \pm 0.3$ in ethane, propane, cyclopropane, neopentane, methylcyclopentane, and cyclohexane. (auth)

15384 OPTICAL SPECTRA AND REACTIVITIES OF RADICAL ANIONS OF 4-NITROBENZYL COMPOUNDS PRODUCED BY PULSE RADIOLYSIS OF ACETONITRILE SOLUTIONS. Burrows, H. D.; Kosower, E. M. (Tel Aviv Univ., Israel). J. Phys. Chem.; 78: No. 2, 112-117(17 Jan 1973).

Electronic absorption spectra are reported for transients formed on pulse radiolysis of acetonitrile solutions of aromatic nitrobenzyl compounds and are assigned to the solute radical anions. Decay of the transients is fairly rapid but is markedly slower in the presence of tetraethylammonium formate. It is suggested that the $\cdot CH_2CN$ radical is responsible for the rapid decay and that formate ion scavenges this species. With 4-nitrobenzyl chloride, the decay of the transient is observed to be second order, in contrast to electrochemical experiments

where first-order decay is observed. With 4-nitrobenzyl fluoride or alcohol, decay of the initially formed transient is accompanied by formation of a new species absorbing at longer wavelength. Identification of the 4-nitrobenzyl chloride anion is supported by first-order decay of the species in water with $k = 4 \times 10^3$ sec^{-1} (found by Hayon and Madhavan). (auth)

15385 FREE RADICALS IN THE SUGAR MOIETY OF X-IRRADIATED DNA. Van de Vorst, A.; Lion, Y.; Calberg-Bacq, C. M. (Univ., Liege). Int. J. Radiat. Biol.; 24: No. 6, 605-608 (Dec 1973).

A brief description is presented of an esr study of x-irradiated solutions of D-ribose, deoxy-D-ribose, their corresponding nucleosides and nucleotides, and DNA. Solutions were respectively in water, 6M H_2SO_4, and 0.5N NaOH. It is concluded that, next to hydrogen abstraction radicals, either in C_3 or C_4, one must consider the existence of radicals corresponding to the abstraction of an OH group in isolated sugars, and to the liberation of a phosphate group in the nucleotide, or in DNA itself. (UK)

15386 PRIMARY PROCESSES IN ACETONE RADIOLYSIS. Robinson, A. J.; Rodgers, M. A. J. (Univ. of Manchester, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 12, 2036-2045(1973).

Acetone molecular ions, produced as primary species during electron beam irradiation of liquid acetone have been observed to exist in two kinetically distinguishable forms: (1) free ions that have excaped the spur and that decay by independent routes, and (2) spurions that are confined by Coulombic interactions and decay in a geminate manner following a $t^{-\frac{1}{2}}$ expression. Added solutes, shown to be reactive towards either free positive or free negative ions also prevent the formation of excited states of acetone excited molecules in a manner that shows that geminate recombination of ion-pairs is the process responsible for their formation. (auth)

15387 EPR STUDY ON THE RADIOLYSIS OF POLYCRYSTALLINE AZIBENZYL. Contineanu, M.; Constantinescu, O.; Oncescu, T. (Univ., Bucharest). Rev. Roum. Chim.; 18: No. 12, 2005-2010(Dec 1973).

The kinetics of radical formation and their disappearance with temperature in irradiated polycrystalline azibenzyl was studied. An appropriate mechanism of radiolysis was proposed. (auth)

15388 ESR OF IRRADIATED SINGLE CRYSTALS OF CYTOSINE. Westhof, E.; Huettermann, J. (Regensburg Univ., Ger.). Int. J. Radiat. Biol.; 24: No. 6, 627-630(Dec 1973).

Preliminary ESR studies were made of x-irradiated single crystals of cytosine. The results were compatible with the presence of H-addition radicals. One was 5,6-dihydro-cytosine-6yl resulting from H-addition at C-5; it is suggested that the other could result from H-addition to O-7. The work is briefly discussed in relation to spectral differences found by other workers. (UK)

15389 RADIATION CHEMICAL SYNTHESES. Hummel, R. W. (Atomic Energy Research Establishment, Harwell, Eng.). Rep. Progr. Appl. Chem.; 57: 683-686(1972).

The review concentrates on processes that have come closest to commercial exploitation, namely the sulfoxidation and sulfochlorination of normal paraffins to produce linear alkane sulfonates for the detergent industry. Brief notes are presented on a selection of other processes that could be commercially significant. (UK)

15390 AGING AND DEGRADATION OF POLYOLEFINS. II. γ-INITIATED OXIDATIONS OF ATACTIC POLYPROPYLENE. Decker, C.; Mayo, F. R. (Stanford Research Inst., Menlo Park, CA). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 11, 2847-2877 (Nov 1973).

Oxidations of bulk atactic polypropylene (PP) have been carried out at 22 and 45°C, and the dependence of rate of formation of each product on rate of initiation was determined. The principal product is PP hydroperoxide, formed in a half-order reaction. One termination product is polymeric dialkyl peroxide, formed in a first-order reaction. Other termination and propagation products, alcohols and carbonyl compounds, are formed in reactions that are mostly first-order in initiation. At 22°C, G_{O_2} is 9-63. G_{PO_3H} is about three times as great at 45°C as at 22°C. Experiments with 2,6-di-tert-butyl-p-cresol shows that it can inhibit all non-cage propagation and all formation of PP hydroperoxide, but that it does not affect cage reactions of initiating radicals and their successors. Only about 16% of the initiating $PPO_2^{\cdot}$ radicals escape the cage at 45°C. Oxidations of PP, n-hexane, and their mixture with both peroxide and γ-ray initiation show that nearly all the initiating radicals escape the cage in solution but that the concentration of $PPO_2^{\cdot}$ radicals is much less than in bulk because of a much faster chain termination. Both the propagation and termination constants for PP oxidation are much faster in solution, but the changes compensate so that $k_p/(2k_t)^{\frac{1}{2}}$ is about the same in solution as in bulk. (auth)

15391 LOCALIZATION OF FREE RADICALS ON IRRADIATED DEOXYRIBONUCLEOHISTONE. Kuwabara, M.; Hayashi, M.; Yoshii, G. (Hokkaido Univ., Sapporo). J. Radiat. Res.; 14: No. 2, 198-203(Jun 1973).

Deoxyribonucleohistone (DNH) from calf thymus was studied by ESR spectroscopy following gamma irradiation. Free radicals formed in gamma irradiated DNH were mainly localized in DNA moiety. The G-value for radical production in DNH was 1.6, while the G-values in DNA and histone were 1.1 and 2.1, respectively. Thus the spectrum obtained in DNH could be explained as a consequence of an electron transfer from histone to DNA. This observation was also confirmed from ESR spectrum of the reconstituted DNH. (auth)

15392 EFFECT OF IONIZING RADIATION ON THE RATE OF THE RANDOM COIL TO DOUBLE-HELIX CONFORMATION CHANGE OF POLY[d(A-T)]. Stephens, J.; Hickey, T. M.; Trumbore, C. N.; Hamori, E. (Univ. of Delaware, Newark). Int. J. Radiat. Biol.; 24: No. 6, 615-619(Dec 1973).

A study was made of the effect of 9.6 krads of ^{60}Co gamma radiation on double helix formation in solutions of poly[d(A-T)], a synthetic nucleic acid copolymer with alternating deoxyadenosine 5′-phosphate and thymidine 5′-phosphate residues. The rate of double-helix formation was measured by monitoring the hypochromicity change at 260 nm. A more than 3-fold decrease was recorded in the reaction rate constant of the fastest first-order process as a result of irradiation. There appeared to be no significant difference in the rate constant of the fast process, whether the poly[d(A-T)] was irradiated in the helix or in the random-coil conformation. (UK)

15393 GRAFT POLYMERIZATION OF VINYL CHLORIDE-VINYL ACETATE ONTO PRE-IRRADIATED POLYETHYLENE. Sasuga, T.; Shimizu, Y.; Sasaki, T.; Tamaki, H.; Araki, K. (Japan Atomic Research Inst., Takasaki, Japan). Kobunshi Kagaku; 30: No. 341, 535-541(Sep 1973). (In Japanese).

The effect of reaction condition on the co-graft polymerization of pre-irradiated polyethylene (I) with vinyl chloride (II) and vinyl acetate mixed monomer system has been investigated. When reaction temperature and the II content in monomer are increased, the weight percent of really grafted I (RPE) and the net percent graft (G_n) increase in the beginning of the reaction. The addition of methanol into the system gives no effect on RPE, while G_n is depressed remarkably. Since G_n increases after the saturation of RPE the propagation of graft chain is presumably consecutive reaction. The reactive amount of monomer unit in the graft chains agrees closely with that determined by MRR in ordinal radical polymerization. (auth)

15394 EFFECT OF IRRADIATION ON ELECTRODE PROCESSES. Part 2. Diffusion Currents Associated With Radiolytic Products. Airey, P. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Chem. Soc., Faraday Trans., I; 69: No. 12, 2103-2111(1973).

The rate of diffusion of radiolytic products to electrode surfaces under steady state conditions is discussed. Account is taken not only of the diffusion coefficients and the bulk concentrations but also of the rates of generation and reaction of products within the diffusion layer. The diffusion current under irradiation is up to two orders of magnitude greater than that calculated classically from Fick's diffusion law. Its value can be estimated from the correlation with a dimensionless quantity which is a function of the dose rate, the diffusion layer thickness, the diffusion coefficient, and the rate of reaction of the intermediates. Experimental evidence is outlined. (auth)

15395 ELECTRON TRANSFER IN GAMMA-IRRADIATED COMPLEXES BETWEEN AROMATIC AMINO ACIDS AND DNA DERIVATIVES. Olast, M.; Bertinchamps, A. J. (Univ., Brussels). Int. J. Radiat. Biol.; 24: No. 6, 589-594(Dec 1973).

An ESR study of γ-irradiated complexes between histamine and nucleotides, tryptamine and nucleosides, and between histamine and DNA showed that the spins were not distributed among the constituents following their radiosensitivity, but localized preferentially on the DNA derivatives. It is suggested that a transfer of electrons occurred, via the stacking of the molecules, during the anionic stage of their radiolysis, from the aromatic amino acids towards the DNA derivatives, i.e., towards the moiety presenting the highest electron affinity. It is suggested that these findings substantiate further the mechanism proposed previously in order to explain the spin transfers observed from purine towards pyrimidine nucleotides in complexes of these constituents. (auth)

15396 UNSTABLE INTERMEDIATES. Pt. 136. A Survey of the Magnetic Properties of $\cdot PL_3$ and $\cdot PL_4$ Radicals: the Radicals

$\cdot P(OH)_3^+$, $\cdot As(OH)_4$, and $(MeO)_2\dot{P}O^-$. Ginns, I. S.; Mishra, S. P.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Dalton Trans.; No. 22, 2509-2514(1973).

Hyperfine coupling constants for a wide range of radicals of type $\cdot PL_3$ and $\cdot PL_4$ are reviewed, and trends as L is varied are displayed and discussed. From these correlations it is concluded that a radical formed by exposure of rigid solutions of phosphoric acid in sulfuric acid to γ-rays is $\cdot P(OH)_3^+$ rather than $\cdot P(OH)_4$, while that formed from similar solutions of arsenic acid is $\cdot As(OH)_4$ rather than $\cdot As(OH)_3^+$. Also, two new radicals formed from trimethyl phosphate are shown to be $(MeO)_3PO^-$ and $(MeO)_2\dot{P}O$. Two radicals whose properties appear to be anomalous in terms of these correlations are $\cdot PO_4^{3-}$ and $\cdot PH_4$. Possible reasons for these anomalies are considered. (auth)

15397 EFFECT OF NITRATE ION ON HYDROXYL RADICAL YIELD IN AQUEOUS SOLUTIONS. Powers, E. L.; Tallentire, A.; Davies, J. V.; Ebert, M. (Univ. of Texas, Austin). Int. J. Radiat. Biol.; 24: No. 6, 637-639(Dec 1973).

Because nitrate ion increases the radiation sensitivity of anoxic bacterial spores in aqueous suspension, and this increase can be suppressed by the hydroxyl scavenger tertiary butanol, NO_3^- was tested directly for its effect on yield of OH·. Experiments were made using a 100-nsec pulse of 8 to 12 MeV electrons delivering ~600 to 800 rads/pulse. Data are presented for the competition between SCN^- and t-butanol for OH· in solutions of $NaNO_3$. Regular competition kinetics were observed in the presence of NO_3^- up to concentrations of 10^{-1} M; at 1 M and 5 M NO_3^-, the competition curves were depressed. It is suggested that NO_3^-, by sequestering e^-_{aq} reduces the reaction $OH\cdot + e^-_{aq} \rightarrow OH^-$, resulting in inhomogeneous increases of OH· concentration. It is pointed out that whereas the absolute highest increase in chemically measured OH· was 10% the maximum increase in anoxic sensitization of the cells is ~40%. (UK)

15398 PULSE RADIOLYSIS: NEW APPROACHES TO THE CLASSICAL TECHNIQUE. Zagorski, Z. P. (Inst. of Nuclear Research, Warsaw). Nukleonika; 18: No. 9, 383-401(1973). (In Polish).

The present status of classical pulse radiolysis is described as well as trends in the further development of this technique (the investigation of radiolysis with nano- and picoseconds time resolution, new optical and electrochemical methods of intermediate species detection). The attention is concentrated on experimental difficulties of particular versions and the achievements are reviewed critically. This paper is the background for experiments being performed in the Institute of Nuclear Research on new techniques of pulse radiolysis. (auth)

15399 PREPARATION OF 5-DEOXYLACTOBIONIC ACID VIA RADIATION CHEMISTRY. Dizdaroglu, M.; von Sonntag, C.; Schulte-Frohlinde, D.; Dahlhoff, W. V. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an de Ruhr, Ger.). Ann. Chem.; No. 9, 1592-1594(1973). (In German).

^{60}Co γ-irradiation of crystalline α-lactose monohydrate yields 5-deoxylactobionic acid with a G-value of about 40 (dose 4×10^{20} eV/g; dose rate 1.3×10^{18} eV/(g × min)). A 60% yield was obtained at a total conversion of 12%. (GE)

15400 IDENTIFICATION OF PRODUCTS FORMED UNDER RADIATION-INDUCED OXIDATION OF 3-PICOLINE. NICOTINIC ACID, 3-PIRIDYL-CARBINOL AND 3-PICOLINE N-OXIDE. Onopko, T. V.; Modyanova, L. V.; Terent'ev, P. B.; Saraeva, V. V. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 5, 571-573(1973). (In Russian).

The radioinduced oxidation of 3-picoline was carried out under continuous oxygen flow, dose rate $3.0 \cdot 10^{16}$ eV/ml · sec, and temperature 25°C. Nicotinic acid, 3-pyridyl-carbinol, and 3-picoline N-oxide were identified among the other products by polarography, chromatography, ultraviolet spectroscopy, mass spectrometry, and electrophoresis. (auth)

15401 EPR STUDIES OF HYDROGEN ATOM REACTIONS WITH DNA BASES AND BASE ANALOGUES IN ACID GLASS. Gedayloo, T. Lawrence, KS; Univ. of Kansas (1973). 164p. University Microfilms Order No. 73-30,812.

Thesis (Ph. D.).

In order to elucidate the chemical factors which influence the reaction of hydrogen atom radicals, H·, with the nucleic acid bases and base analogues in an aqueous environment and to attempt to identify and elucidate the structure of these radicals, the paramagnetic species produced in nucleic acid bases and base analogues were studied by electron paramagnetic resonance (EPR) spectroscopy. The biological molecules studied were: thymine, cytosine, uracil, adenine, guanine, 6-azathymine, 5-methylcytosine, 6-methyluracil, orotic acid, iso-orotic acid, barbituric acid, 5-bromouracil, 8-azaadenine and 8-azaguanine in ^{60}Co gamma-irradiated H_2SO_4 glass at 77°K. Trapped hydrogen atom radical, $H^\cdot_\beta$, kinetics as a function of temperature were studied. Free radical species of above molecules were formed by annealing the glass samples to temperatures of 180°-189°K. All EPR studies were carried out at 77°K. It was observed that in general, the reaction of H·atoms, in pyrimidines and related compounds, is with the 5,6 double bond. In purine and their analogues, H·atom attack takes place at the 7,8 double bond. No other free radical species or precursers to 5,6 dihydrothymine-5-yl, 5-thymyl, were observed in irradiated thymine glass. A search for the reported radical of thymine formed by the attachment of H·atom to the carbonyl oxygen at 4 position proved unfruitful. A very low intensity doublet at 77°K may be attributed to the presence of this species. Presence of other than previously reported radical species observed in polycrystalline powders or single crystal forms was detected for a number of the above biological molecules, in this investigation. (LK)

15402 VALIDITY OF EXPERIMENTAL TESTS FOR CHAIN REACTIONS IN BATCH REACTORS. Axtmann, C.; Mahoney, J. A. (Princeton Univ., NJ). Chem. Eng. J. (Lausanne); 3: 156-162(1972). (NYO-2807-80).

Gas-phase chain reactions are investigated for radiolytic and photochemical batch reactors. The steady state treatment leads to a nonlinear equation of continuity when there is competition between volume termination and wall termination of the chain carriers. The equation is solved analytically for several limiting cases and numerically for a range of experimental conditions. For many situations of experimental interest, and particularly ones that involve short chains, the numerical solutions indicate that the reaction yield may be remarkably insensitive to either pressure or dose rate. In such circumstances the existence of a chain reaction might easily be masked, as is demonstrated by an analysis of experiments on isotopic exchange in nitrogen gas. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 15321.

Hot-Atom Chemistry

Refer also to abstracts 15368 and 17703.

15403 (COO-2190-10) CHARACTERIZATION OF THE COLLISIONAL DISTRIBUTION FUNCTION IN RECOIL SYSTEMS. Spicer, L. D.; Malerich, C. J. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). [nd]. Contract AT(11-1)-2190. 14p. (CONF-730961-2). Dep. NTIS $3.00.

From seventh international hot atom chemistry symposium; Juelich, F. R. Germany (10 Sep 1973).

The model for collision density most frequently used in kinetic treatments of recoil data is based on elastic isotropic scattering and treats inelastic collisions corresponding to reaction in a simple and tractable manner but neglects other inelastic contributions. The effect of several inelastic processes on the collision density function for the system of recoil tritium in the presence of hydrogen was studied. Two categories of inelastic processes are: those collisions leading to reaction giving molecular products and those collisions involved primarily in merely degrading the energy of the hot atom. The study showed that reaction is by far the most important perturbing influence on the distribution function although other specific inelastic processes might be important in various energy regions for calculations requiring a precise collision density. (LK)

15404 (FRNC-R-32) CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS. 1972 Bibliography. Adloff, J. P. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Centre de Recherches Nucleaires). 1972. 34p. (In French and English). Dep. NTIS (U. S. Sales Only) $3.75.

This bibliography contains 178 articles presented in alphabetical order on the chemical effects of nuclear transformations (in particular the chemistry of hot atoms). A subject index classifying the different articles reviewed in terms of elements and isotopes is also presented together with an author index. (FR)

15405 (UCD-34-P-158-X-2) HIGH ENERGY ATOMIC CHEMISTRY AND CHEMICAL RADIATION EFFECTS. Progress Report, January 1, 1973 – December 31, 1973. (California Univ., Davis (USA). Dept. of Chemistry). 1973. 20p. Dep. NTIS $3.00.

Research progress is reported on high energy atomic chemistry studies that include stopping power research; classical trajectory calculations; F to HF abstraction reactions; hot substitution reactions; and fast neutron dosimetry. A listing is included of technical

publications resulting from the research and manuscripts in preparation. Abstracts of technical papers scheduled for presentation are also included. (DHM)

15406 ANNUAL REVIEW OF PHYSICAL CHEMISTRY. Volume 24. Eyring, H. (ed.). Palo Alto, CA; Annual Reviews Inc. (1973). 954p. $12.00.

Twenty-one sections are included; four have been abstracted separately for NSA. The remaining topics include: physical chemistry in Cambridge, Mass., high speed liquid chromatography, internationally recommended names and symbols for physicochemical quantities and units, gas phase reaction kinetics, Raman spectroscopy involving electronic levels, status report on critical compilation of physical chemical data, the structure of simple liquids, optical properties of polymers, chemistry of pollutant formation in flames, statistical mechanics of simple polar fluids, computer dynamics, chemistry of the planets, artificial intelligence and machines that understand, theory of rotational and vibrational energy transfer in molecules, liquid crystals, picosecond spectroscopy, and dynamical aspects of gas–solid interactions. (JGB)

For abstracts of individual papers see: 15351, 15407, 16149, and 16846.

15407 REACTIONS OF HIGH KINETIC ENERGY SPECIES. Dubrin, J. (Univ. of California, Livermore). Annu. Rev. Phys. Chem.; 24: 97-120(1973).

Significant advances made during the past ten years are discussed under the following section headings: sources of high kinetic energy species, including bulb techniques and molecular beams; reactivity–excitation functions, including reactions with negligible energy barriers, reactions with energy barriers, excitation functions in the absence of reactant vibrational excitation, and energy dependence in the presence of reactant vibrational excitation; microscopic mechanisms; direct reactions, including high energy stripping modes and simple exchange reactions; hot atom chemistry of atomic tritium, including general features, substitution reaction, models, and prognosis-nuclear recoil studies. (103 references) (JGB)

15408 NUCLEAR DATA REQUIRED FOR THE INTERPRETATION OF HOT-ATOM CHEMISTRY. Aten, A. H. W. (EURATOM, Geel, Belgium). pp 383-389 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

In hot-atom chemistry radioactive atoms are released by two processes from the bonds joining them to the molecule in which they were originally contained. Either emission of a particle or a photon gives a recoil to the radioactive atom or a positive charge is given to the atom in question during the radioactive transformation and this charge, if sufficiently high, releases the atom. To understand what happens in hot-atom chemistry knowledge of these two phenomena is essential. In the case of neutron capture, the gamma processes determine the value of the recoil energy. The situation is even more difficult in those cases where bonds are broken by a positive charge. This may either be caused by the absence of electron pairs responsible for the chemical bond or by electrostatic repulsion between different parts of the charged molecule. In this case, the essential information is the value of the positive charge (or rather the fraction of cases in which each charge occurs). Positive charges normally arise from electron capture or from conversion of gamma rays. In the latter case, it is also essential to know the delay between the radioactivity process and the production of the converted gamma rays. (auth)

15409 VARIATION IN THE ABSTRACTION ISOTOPE EFFECT FOR ENERGETIC TRITIUM ATOMS. Baker, R. T. K.; Malcolme-Lawes, D. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Chem. Soc., Chem. Commun.; No. 24, 941-942(19 Dec 1973).

The HT/DT yield ratio from the reaction of energetic tritium atoms with 1 : 1 mixtures of protonated and deuterated alkanes is found to fall on addition of neon as moderator. (auth)

15410 THEORY OF THE KINETIC ISOTOPE EFFECT OF RECOIL ATOM REACTIONS IN GASEOUS MIXTURES. Brodsky, A. M. (Inst. of Electrochemistry, Moscow); Temkin, A. Ya. (Inst. of Electrochemistry, Moscow). Radiochim. Acta; 18: No. 4, 180-189(1973). (In French).

The kinetic isotope theory is considered for reactions of recoil T atoms in the following ternary gaseous mixtures: (CH_4, CD_4, Ne), (C_2H_6, C_2D_6, Ne), (C_3H_8, C_3D_8, Ne), (CD_4, C_2H_6, Ne or CF_4), (CH_4, C_2D_6, Ne), (CD_4, C_3H_8, Ne), (CH_4, C_3D_8, Ne), (C_2D_6, C_3H_8, Ne), and (C_2H_6, C_3D_8, Ne) studied experimentally by Baker and Wolfgang. It is shown that the observed behavior of HT/DT as a function of the concentration, c, of the moderator (Ne or CF_4) can be obtained theoretically by basing it on the hypothesis according to which the corresponding cross sections have resonance maxima. The values for the effective mass, M', of the bombarded atom have been calculated for CH_4, C_2H_6, C_3H_8, and the corresponding deuterated compounds by means of the experimental results of Baker and Wolfgang. The values of the product of the reaction width and the resonance energy (in the system having M' as the center of mass and that of the T atom) have been calculated (in relative units) starting with the limiting values of HT/DT when $c \to 1$. (tr-auth)

Properties of Radioactive Materials

Refer also to abstracts 15276, 15326, 16122, 16153, and 17299.

15411 INTERACTION OF SOME SULFUROUS COMPOUNDS OF URANIUM WITH OXYGEN. Koval'chuk, V. Yu.; Dunaeva, K. M.; Ippolitova, E. A.; Dubrovin, A. V.; Zhirov, A. I. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 5, 574-579(1973). (In Russian).

The behavior of uranium oxysulfide (UOS) and disulfide (β-US_2) in oxygen (dry and moist) was studied by DTA, TGA, x-ray technique, and chemical analysis. The majority of the reactions occurring in the oxidation process was identified. Uranyl sulfate turned out to be the basic product of oxidation. (auth)

15412 PROPERTIES OF CHEMICAL COMPOUNDS OF THE TRANSACTINIDES 104 TO 117: A PREDICTION. Hoffmann, P. (Technische Univ., Darmstadt, Ger.). (1973). vp.

In order to perform rapid radiochemical separations of the superheavy elements in the gaseous phase, the knowledge of thermodynamic data of compounds of these elements is required. An extrapolation method is used that enables the properties of unknown compounds to be inferred from those of known homologue compounds. The assumption for this kind of extrapolation is that no changes in electronic and molecular structure occur within the groups of the periodic table. In most cases this condition is satisfied by compounds having bonds with pronounced homopolar character, whereas the approach cannot be applied to those with ionic bonds. The boiling points of some hydrides, methyl and ethyl compounds and chlorides of the elements 113–117 are calculated according to this method. (GE)

15413 DIRECT HYDROGEN-1 AND PHOSPHORUS-31 NUCLEAR MAGNETIC RESONANCE CATION SOLVATION STUDY OF $Al(ClO_4)_3$, $Ga(ClO_4)_3$, $In(ClO_4)_3$, $UO_2(ClO_4)_2$, AND $UO_2(NO_3)_2$ IN WATER-ACETONE-DIMETHYLSULFOXIDE AND WATER-ACETONE-HEXAMETHYLPHOSPHORAMIDE MIXTURES. Fratiello, A. (California State Univ., Los Angeles); Vidulich, G. A. Cheng, C.; Kubo, V. J. Solution Chem.; 1: No. 5, 433-444(Nov 1972).

A competitive solvation study of $Al(ClO_4)_3$, $Ga(ClO_4)_3$, $In(ClO_4)_3$, $UO_2(ClO_4)_2$, and $UO_2(NO_3)_2$ in water–acetone–dimethylsulfoxide (DMSO) and water–acetone–hexamethylphosphoramide (HMPT) mixtures has been carried out by direct ^1H and ^{31}P nuclear magnetic resonance (NMR) techniques. At low temperature, proton and ligand exchange are slow enough in these systems to permit the observation of signals for bulk and coordinated molecules of water and the organic bases (DMSO and HMPT). Both DMSO and HMPT compete effectively with water for coordination sites in the Al^{3+}, Ga^{3+}, and In^{3+} systems, with steric effects dominating the HMPT results. Both Al^{3+} and In^{3+} are able to bind a maximum of two to three HMPT molecules, for example. In contrast, UO^{2+} is solvated selectively by the organic molecules to the allowed maximum of 4 molecules per cation. ^1H and ^{31}P NMR spectral results support the formation of only the mono-, tri-, and tetra-HMPT solvation complexes. (auth)

15414 SELECTION CRITERIA FOR INDUSTRIAL MACHINERY FOR THE DECONTAMINATION OF RADIONUCLIDE CONTAMINATED MATERIALS. Panciatici, G.; Lo Moro, A. (CAMEN, San Piero, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 3, 150-154 (1972). (In Italian).

Selection criteria used on the Italian-market regarding machinery for industrial cleaning operations are presented in view of their employment for decontamination of radionuclide contaminated materials. Some details of design and operation features of selected machinery are considered and modifications to obtain a more effective decontamination are suggested. (auth)

15415 STUDIES OF THE HEAVIEST ELEMENTS AT DUBNA. Zvara, I. (Joint Inst. for Nuclear Research, Dubna, USSR). (1973). vp.

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

Recent works of several Dubna groups on the transactinide and

superheavy elements are reviewed. New experiments on the volatility properties of kurchatovium and nielsbohrium halides were performed. Some fast techniques, based on gas thermochromatography of volatile inorganic species, were developed for the chemical identification of elements beyond 105 as well as for the superheavy elements. Using germanium and xenon ion beams, available for the first time, the yields of various activities produced in the bombardment of uranium and other targets were measured to elucidate the interaction patterns of these extremely heavy bombarding particles. Superheavy elements were looked for in the reaction products. (GE)

15416 COLOR OF URANYL-BEARING MINERALS. Platonov, A. N.; Povarennykh, A. S.; Tarashchan, A. N.; Bondar, V. V. (Inst. of Geochemistry and the Physics of Minerals, Kiev). Zap. Vses. Mineral. Obshchest.; 101: No. 6, 423-428(Nov 1972). (In Russian).

Analysis of the optical absorption spectra of uranyl minerals showed that their color has a similar nature and is caused by the absorption of the uranyl group UO_2^{2+}. Differences in color of the individual minerals and the diversity of the shades and tones are connected with differences in the comparative intensities of the bands (spectral series) in the range of the structural absorption spectra. The character of the optical spectra of uranyl minerals is determined by the symmetry of the uranyl complexes, which depends on the quantity and type of ligand atoms in the equatorial plane and on the individual properties of the cations entering into the second coordination sphere of the U atom. The optical absorption spectra, reflecting the structural parameters of the uranyl complexes, can be used for the analysis of the crystalline characteristics of the uranyl-containing minerals. (tr-auth)

15417 INVESTIGATION OF THE $UO_3-UO_2(NO_3)_2-H_2O$ SYSTEM. Efimova, V. C.; Gromov, B. V. At. Energ. (USSR); 35: No. 1, 57-59(Jul 1973). (In Russian).

Solutions of uranyl nitrate and uranium trioxide were kept in sealed vessels at room temperature for a period of 1.5 yr in order to attain equilibrium. The solutions were shaken occasionally. Two solid phases were detected. The composition phase A corresponded to the formula $UO_3 \cdot 2H_2O$ or $UO_2(OH)_2H_2O$. Phase B was a basic uranyl nitrate salt corresponding to the formula $6.1\ UO_3 \cdot 0.5N_2O_5 \cdot 25H_2O$. Data on the dialysis of equilibrium solutions at 20°C show that there are primarily dimers in equilibrium with phase A, and tetramers in equilibrium with phase B. Thus the precipitation of uranyl hydroxide is accompanied by the formation of dimer complexes. (SJR)

15418 REPRODUCIBILITY OF THE RESULTS OBTAINED BY METHODS FOR THE ROUTINE RADIOCHEMICAL PURITY CONTROL OF $Na^{131}I$. Zelenay, K.; Nowak, K.; Pasternak, A. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 18: No. 9, 417-430(1973). (In Russian).

In order to choose a method for the routine radiochemical purity control of $Na^{131}I$ a comparison of results obtained with use of three paper, one thin-layer chromatographic, and two paper electrophoretic methods has been made. As result of this investigation two methods are proposed as routine: paper electrophoresis in veronal buffer with pH = 8.6, ionic strength 0.12, potential gradient 7-16 V/cm for I-determination, and for 10^- determination ascending paper chromatography on Whatman 1 with use n-butanol + dioxan + 2N ammonia (4 : 1 : 5) mixture as developer. (auth)

15419 X-RAY INVESTIGATION OF THE COORDINATION AND THE HYDROLYSIS OF THE URANIUM(IV) ION IN AQUEOUS PERCHLORATE SOLUTIONS. Pocev, S.; Johansson, G. (Kungliga Teknisha Hoegskolan, Stockholm). Acta. Chem. Scand.; 27: 2146-2160(1973).

Coordination of the uranium(IV) ion in acid and hydrolyzed water solutions of uranium(IV) perchlorate has been investigated by means of x-ray scattering measurements. Analysis of the scattering data indicates a well-defined inner coordination sphere around the uranium(IV) ion with a coordination number which is not significantly different from eight. The perchlorate groups do not enter the inner coordination sphere but seem to form outer-sphere complexes. In hydrolyzed solutions polynuclear hydrolysis complexes are formed with a shortest U-U distance within the complexes of 4.0 Å. This is indicative of the formation of a double hydroxo bridge between the uranium atoms. (auth)

15420 ELECTRONIC SPECTRA AND MAGNETIC CIRCULAR DICHROISM OF THE URANYL ION. II. The Effect of Reduced Symmetry on the Spectra. Brint, P.; McCaffery, A. J. (Univ. of Sussex, Brighton, Eng.). J. Chem. Soc., Dalton Trans.; No. 1, 51-55(1974).

The absorption and m.c.d. (magnetic circular dichroism) spectra of the dinitrate, trinitrate, and tetranitrate complexes of the uranyl ion were examined and the results interpreted in terms of an axial symmetry perturbation on the $D_{\infty h}$ states characterized in Part I [Brint et al., Mol. Phys. 25, 311 (1973)]. This gives a consistent account of the m.c.d. spectra at liquid-helium temperatures. The striking changes in structure observed in the absorption spectrum of the dinitrate complex in various solvents were also investigated and quantitative estimates of reduction in symmetry from changes in the excited state moment were obtained. (auth)

15421 AMIDE COMPLEXES OF URANIUM TETRAHALIDES AND URANYL CHLORIDE. Bagnall, K. W.; Du Preez, J. G. H.; Bajorek, J.; Bonner, L.; Cooper, H.; Segal, G. (Univ. of Manchester, Eng.). J. Chem. Soc., Dalton Trans.; No. 23, 2682-2686(1973).

Uranium tetrachloride and tetrabromide from 1:2 complexes with amides of the type $R^1 \cdot CO \cdot NR^2R^3$ when R^1 or R^2 and R^3 are bulky branched chains ($R^1 = CMe_3$, Me_2CHCH_2, or Me_2CH with $R^2 = R^3 = Me$, and $R^1 = Me$ with $R^2 = R^3 = Pr^i$) but form 1:4 complexes when $R^1 = Me$, $R^2 = H$, and $R^3 = Et$ or Pr^i. The corresponding uranyl chloride complexes are all of composition UO_2Cl_2, 2L except where L is $CH_3CONHEt$, when a 1:3 complex is obtained. IR spectroscopic results are reported for these, and some analogous thorium tetrachloride complexes. Studies of the uv to visible spectra of the complexes UX_4, 4L indicate that 1:2 complexes are formed first in the reaction of the tetrahalide with the ligand and that the 1:4 complexes react with halide ion in non-aqueous solvents to form octahedral anions $[UX_5L]^-$ and $[UX_6]^{2-}$. (auth)

15422 ELECTROCHEMICAL REDOX PROCESSES OF URANIUM IN AQUEOUS SOLUTIONS OF ACETYLACETONE. Cosovic, B. (Inst. Ruder Boskovic, Zagreb); Jeftic, L.; Branica, M.; Galus, Z. Croat. Chem. Acta; 45: No. 3, 475-487(1973).

Electrochemical redox processes of uranium(VI) and uranium(V) in aqueous solutions of acetylacetone were studied by means of various electrochemical techniques. The presence of acetylacetone accelerates the rate of disproportionation of uranium(V), even under conditions such that uranium(VI) is not in the form of the acetylacetonato complex. The corresponding rate constants of disproportionation were determined. The influence of the acetylacetonato ion concentration on the potential and on the rate of the uranium(VI)-uranium(V) electron transfer was investigated by means of cyclic voltammetry and square-wave polarography. Both reduction and oxidation of uranium(V) were investigated by using the Kalousek commutator technique. A mechanism for those processes is proposed. It was proved by electrocapillary measurements that besides the adsorption of acetylacetone, adsorption of several uranium acetylacetonato species plays an important role in the overall mechanism. Taking into account the experimental results, the redox processes of uranium(VI) and uranium(V) in the presence of acetylacetone can be explained in terms of an ECE mechanism. (auth)

15423 REACTION OF AMMONIUM PERTECHNETATE WITH ANHYDROUS HYDROGEN FLUORIDE. Vibrational Spectra of Pertechnetyl Fluoride. Binenboym, J.; El-Gad, U.; Selig, H. (Soreq Nuclear Research Center, Yavne, Israel). Inorg. Chem.; 13: No. 2, 319-321(Feb 1974).

Ammonium pertechnetate dissolves slightly in anhydrous hydrogen fluoride to give solutions of pertechnetyl fluoride. Raman spectra of the solutions as well as infrared and Raman spectra of the pure compound indicate that TcO_3F has symmetry C_{3v} with the following assignments (in cm^{-1}): (a_1) 696, 962, 317; (e) 951, 347, 231. A comparison with other MO_3X compounds indicates a necessity to reverse some of the original assignments. (auth)

Radioactive Waste Treatment

15424 (INIS-mf-766-10, pp 1-18) PROCESSING OF WASTE WATER IN CHEMICAL DRESSING PLANTS OF THE URANIUM INDUSTRY INTO RE-USABLE SUBSTANCES. Klicka, V. (Chepos, Prague). [nd]. (In Czech).

A method of waste water processing in chemical dressing plants of the uranium industry is proposed, based on the results and experience from the construction of installations for the disposal of high-activity waste waters from nuclear power stations. The distillation of dissolved salts and their solidification are the basic decontamination procedures. The improvement was studied of the proposed method concentrating mainly on a useful utilization of the "product" of the disposal. A pilot plant is being built to verify the proposed method, shown in a diagram. It is estimated that the costs of waste water decontamination will amount to approx. 15 Czechoslovak crowns per 1 m^3. (INIS)

15425 DINONYLNAPHTHALENESULFONIC ACID AS A LIQUID ION EXCHANGER FOR RADIOACTIVE LIQUID WASTES DISPOSAL. III. The Use of Sodium Dinonylnaphthalenesulfonate.

Wang, S. M.; Cheng, W. L.; Hsu, C. N.; Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan). Radioisotopes (Tokyo); 22: No. 10, 551-555(Oct 1973).

The selectivity coefficients of sodium dinonylnaphthalenesulfonate (NaD) for Cs(I) and some rare earth elements have been determined. Although the NaD extracts M(III) in the form of $MClO_4^{+2}$, it has a strong extraction ability, and can be used for the treatment of neutral radioactive waste solution. The easily prepared sodium hydrogen dinonylnaphthalenesulfonate (NaHD) can also be used in addition to NaD, and its organic solution in the presence of synergistic agent, n-trioctylphosphine oxide, has shown to be very effective for the wastes treatment. The column method with packed bed and batch shaking method are demonstrated. (auth)

Radioisotope Production

Refer also to abstracts 16111 and 16112.

15426 (CNEA-351) OBTAINING PERTECHNETATE SOLUTIONS (Tc-99m) WITH HIGH ACTIVITY CONCENTRATION. Karpeles, A.; Rivero, M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 19p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

A solvent extraction procedure for preparation of carrier-free Tc-99m solutions with high activity concentration is described. Irradiated molybdenum oxide is dissolved in sodium hydroxide solution; the technetium, product of molybdenum decay, can periodically be extracted with methyl ethyl ketone. The organic phase is then purified by ion exchange. The solvent is evaporated under reduced pressure and the residue is taken up in isotonic saline solution. The complete process yield is over 90% and the activity of the final solution has a concentration that depends on the volume of saline used. It is possible to obtain solutions with some tens of millicuries ^{99m}Tc per milliliter. The methyl ethyl ketone concentrations in the final solution are below 1%, the pertechnetate content is over 99% and the radionuclidic purity is higher than 99% ^{99m}Tc. (auth)

15427 STERILE GENERATOR HOUSING AND SUPPORT. Czaplinski, T. V.; Bruno, G. A.; Haney, T. A. (to E. R. Squibb and Sons, Inc.). US Patent 3,783,291. 1 Jan 1974. Filed date 3 Jan 1972. 4p.

A new apparatus for eluting sterile non-pyrogenic radioactive material safely, effectively, and with a minimum of radiation exposure to the operator is described. This unit comprises a support base that supports a housing for a sterile generator, said support base having notched sleeves incorporated therein. (Official Gazette)

15428 PROBLEMS OF FABRICATING ^{238}Pu OF BIOMEDICAL QUALITY. Berger, R. (CEN, Fontenay-aux-Roses, France); Devillers, C.; Gervaise, F.; Le Coq, G. pp 329-334 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

The biomedical quality of ^{238}Pu used as a heat source for artificial hearts presupposes the lowest possible ^{236}Pu concentration, this being determined by irradiation methods. The results of the chemical analysis of ^{237}Np samples irradiated in reactors have been compared with the results of calculation. A good knowledge of the cross-sections $\sigma_{\gamma,n}$ et $\sigma_{n,2n}$ of ^{237}Np is necessary for calculating the ^{236}Pu concentration and for optimizing the irradiation conditions. Evaluations having shown that it was difficult to estimate these data correctly in the present state of knowledge, $\sigma_{\gamma,n}$ was measured. By slightly adjusting the calculated results for the experimental results it may be possible to produce ^{238}Pu of satisfactory quality. (auth)

15429 APPLICATION OF NUCLEAR DATA IN THE PREPARATION OF RADIONUCLIDES FOR USE IN MEDICINE AND BIOLOGY. Persson, R. B. R. (Univ. of Lund, Sweden). pp 359-373 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

At the IAEA Consultants' Meeting held December 11, 1972, at Studsvik, Sweden, nine experts in various fields of experience gathered in order to exchange information on the application of nuclear data in the preparation of radionuclides for use in medicine and biology. For reactor-produced radionuclides, it was concluded that the averaged thermal neutron cross-sections for the production of all useful radionuclides are required with an accuracy within a few per cent. Accurate decay-scheme data are also needed. Furthermore, cross-section data for the resonance region 5 eV – 1 MeV are not well known for many materials and better information is required. For radionuclide generators, the main problem is to evaluate the best production techniques for the parent radionuclide and to obtain a daughter nuclide with high radionuclide purity. The data needs to meet these requirements were discussed. Similar data needs for the production of radionuclides by accelerators were discussed. Furthermore, it was suggested to use the number of transformations per particle (R) or its inverse as a standard to express the production yield of radionuclides by charged-particle reactions. Radionuclide production with fast neutrons and photons was also discussed as well as some general problems concerning production-parameters, toxicology, etc. (auth)

15430 EXPERIENCES IN RUNNING AN ION-EXCHANGE SYSTEM AT PRESSURES OF 200 ATM AND AT HIGH RADIATION LEVELS. Schuetz, B.; Specht, S. (Technische Univ., Munich). (1973). vp.

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

A laboratory-scale plant for the separation of 100 Ci Cm from gram amounts of ^{241}Am using high pressure ion exchange chromatography is described. Special attention is paid to the change in system performance by radiolytical damage to the ion-exchange resin. A decrease in separation factor and an increase in asymmetry of the Cm-band are noted. (GE)

15431 PRODUCTION OF BISMUTH-204 FOR MEDICAL USE. Kinsley, M. T.; Lebowitz, E.; Baranosky, J. (Brookhaven National Lab., Upton, NY). Int. J. Nucl. Med. Biol.; 1: No. 2, 85-92 (Nov 1973).

A method is described for producing practical quantities of high-purity ^{204}Bi by the ^{206}Pb(p,3n)^{204}Bi reaction. A simple electrolytic separation method with good yield has been developed. The cross section for the above reaction was calculated for 32-MeV protons. Decay data for ^{204}Bi-$^{204\,m}$Pb equilibrium samples are also reported. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 15285 and 15665.

15432 (DOCKET-50201-147) WEST VALLEY REPROCESSING PLANT. Safety Analysis Report, Volume 1. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 1973. 776p. Dep. NTIS $41.00.

Part I of the safety analysis report for the West Valley Reprocessing Plant is presented that considers site description, design criteria, process development, and confinement systems. (DHM)

15433 (GERHTR-59) DEVELOPMENT OF A METHOD AND EXPERIMENTAL INSTALLATION FOR PREFABRICATING HTGR FUELS. Zimmer, E.; Naefe, P.; Ringel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). 1973. 6p. Dep. NTIS $3.00.

Work Performed under United States–German High Temperature Reactor Research Exchange Program.

A description is given of the Juelich KFA precipitation process, which was developed for the quick, continuous, refabrication of bred ^{233}U as coated fuel particles. Droplets of metal salt solution are formed in an aqueous ammonia solution containing a ketone as a second phase. The nozzle is immersed in the ketone layer. The operation and performance of the process are described. (DLC)

15434 (JUL-943-CT) STUDY ON THE PROCESSING AND FURTHER TREATMENT OF SPENT FUEL ELEMENTS FROM THORIUM HIGH TEMPERATURE REACTORS WITH SPHERIC FUEL ELEMENTS. Jauer, H.; Laser, M.; Merz, E.; Storch, S.; Tillessen, U. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Apr 1973. 79p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

This study on the processing and further treatment of spent fuel elements from thorium high-temperature reactors deals mainly with the treatment of fuel elements from the THTR-300 prototype nuclear power plant. In addition, an attempt was made to evaluate the consequences arising from the extrapolation of a nuclear plant capacity of 5,000 MWe with pebble bed reactors. The alternatives discussed in the paper include: (1) the reprocessing of the spent fuel elements in the WAK (Karlsruhe reprocessing plant) or in a commercial plant, (2) ultimate disposal of the fission products after separation from the graphite matrix and solidification, (3) ultimate disposal of the entire fuel elements. As regards the processing of THTR-300 fuel elements, it is recommended to reprocess the elements after an intermediate storage period in a future commercial plant in case the uranium contained in these elements is suitable for re-use. The problem of whether large amounts of irradiated nuclear fuels should be ultimately disposed of in salt mines has not yet been settled. (GE)

15435 (NLCO-1044) RECOVERY OF URANIUM FROM PIQUA COLD SCRAP FUEL ELEMENTS. Miller, G. P. (National Lead Co. of Ohio, Cincinnati (USA)). Jun 1969. Contract AT(30-1)-1156. 24p. Dep. NTIS $3.25.

The Piqua cold scrap was declad, digested, and the contained uranium extracted with a material loss of 0.28%, based on uranium feed weight. The molybdenum in the alloy required additions of ferric nitrate in the digestion operation to prevent the formation of uranyl polymolybdate solids, and extraction conditions had to be selected to determine if the molybdenum had a detrimental influence on the extraction system. The total cost, which includes material losses for the recovery of the uranium from the Piqua cold scrap, was $19,689 or $2.75 per pound of uranium feed. The downgrading cost of $19,689 was not included in the total cost because it was necessary to use the Piqua cold scrap, originally scheduled for the 2% ^{235}U campaign, for the 0.947% ^{235}U enriched campaign. The National Lead Company of Ohio out-of-pocket cost estimate to the AEC was $1,355, but the actual AEC out-of-pocket cost was $2,314. The higher than estimated AEC out-of-pocket cost was due primarily to a decision on a mechanical decladding route rather than the planned lower cost chemical decladding process. The mechanical process was chosen to avoid equipment priority problems in drum digestion, to make the best use of manpower available at the time, and for convenience in materials control. The special surveillance was undertaken to demonstrate and record that the large-scale FMPC facilities can process relatively small quantities of special material for uranium recovery at low cost and minimum material loss. Costs were $3,778. All phases of Piqua recovery operations were routine and without problems except that a shipper-receiver difference of 58 U pounds was detected during the process and was verified by the overall material balance. The gross fuel element weights, however, were in agreement. (auth)

15436 (RT/CHI-(73)6) EFFECTS OF PROCESS DESIGN ON THE OUTLOOK FOR INDUSTRIAL PLANTS FOR NUCLEAR FUEL REPROCESSING. Moccia, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1972. 33p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.75.

Considering present development of technology of irradiated fuel reprocessing and present trends in the treatment, release and conditioning of the wastes, influences of process design are outlined on the planning of industrial plants. (auth)

15437 OXIDATION OF NEPTUNIUM(V) IN NITRIC SOLUTION AND THE BEHAVIOR OF NEPTUNIUM-237 DURING PUREX EXTRACTIONS. Gourisse, D. (CEN de Fontenay-aux-Roses, France); Moulin, J. P.; Arnaud, G.; Kikindai, T. (1973). vp. (In French).

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

In order to optimize Np recovery from irradiated fuels, the behavior of Np in nitric solutions has been studied. The following topics have been dealt with: investigation method, equilibrium constant of the oxidation reaction, velocity constant, distribution coefficient of Np, mode of operation, flowsheets, neptunium recovery by solvent extraction. (GE)

15438 SECONDARY AMINES FOR PLUTONIUM PROCESSING AND PURIFICATION. Koch, G.; Schoen, J. (Kernforschungszentrum, Karlsruhe, Ger.). vp.

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

Secondary amines of the Amberlite LA-2 type have been studied in order to test their applicability as extractants for final-cycle plutonium purification in reprocessing. On the basis of these studies a flowsheet has been developed which will lead to a highly purified plutonium product in a continuous, all-nitric-acid process. (GE)

ENGINEERING

Energy Conversion

Refer also to abstract 16140.

15439 (AEC-tr-7467) CURRENT STATUS OF RADIOISOTOPE-POWERED ARTIFICIAL ORGANS. Toyoshima, E.; Hori, M. Translated from Jinko Zoki; 1: No. 4, 256-269(1972). 50p. Dep. NTIS $4.50.

With respect to the basic problem of an energy source (power source) for implant-type artificial organs, the status of high-reliability long-life (10 years) power sources (particularly ^{238}Pu), replacing in part the previously used commercial mercury cell, and similar power sources, particularly in relation to artificial heart pacemakers already in practical use, is reviewed. Foreign papers are introduced, and a simple description of auxiliary artificial organs in connection with animal experiments is also given. (auth)

15440 (TID-25036) PROCEEDINGS OF NUCLEAR POWER SYSTEMS CLASSIFIED SESSION, THIRD INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE (IECEC), NATIONAL BUREAU OF STANDARDS, BOULDER, COLORADO, AUGUST 13–16, 1968. (National Bureau of Standards, Boulder, Colo. (USA)). 1968. 179p. Dep. NTIS $11.00.

Declassified 27 Nov 1973.

Topics discussed include: programmatic evaluation of SNAP-19 intact re-entry heat source development program; SNAP 19 aerospace nuclear safety evaluation; aerothermal analysis and testing of the SNAP-19 intact re-entry heat source; SNAP-27 radioisotopic thermoelectric generators; compact thermoelectric converter program; experimental evaluation of an automatic temperature controlled heat pipe; conceptual design of a radioisotope heat pipe thermionic space power system; fast reactor systems for secondary space power; and a 15 kW(e) modular thermionic thermal reactor (MATTRAC). (TFD)

15441 MATERIAL FOR DIRECT THERMOELECTRIC ENERGY CONVERSION WITH A HIGH FIGURE OF MERIT. Nicolaou, M. C. US Patent 3,782,927. 1 Jan 1974. Filed Date 24 Aug 1971. 8p.

In devices used hitherto for the direct conversion of heat into electricity, commonly known as "thermoelectric energy converters," the efficiency of conversion is appreciably lower than that of conventional reciprocating or rotary heat engines. The basic reason for this low efficiency is inherent in the physical properties of the materials selected for the manufacture of these devices. The materials that have been and are currently being used for this purpose are intermetallic compounds and alloys of silicon and germanium. In this invention an entirely new material is developed. It is composed of an alloy or solid solution of the three intermetallic compounds: magnesium stannide, magnesium germanide and magnesium silicide, and defined by the chemical formula: $Mg_2Si_xGe_ySn_{1-x-y}$. This material, when properly doped, possesses a figure of merit and, consequently, an efficiency of direct conversion of thermal energy into electrical energy far exceeding that of any other material previously known or used. (Official Gazette)

15442 NUCLEAR DATA REQUIREMENTS IN THE DESIGN OF THE BIFOLD NUCLEAR POWER SOURCE. Stubbins, W. F.; Wolfe, R. A. (Univ. of Cincinnati). pp 51-69 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

The BIFOLD Nuclear Power Source joins SNAP isotopic heat source and SNAP reactor technology to provide reliable uninterruptable base power which is augmented during periods of high-demand power by operation in a critical reactor mode. Plutonium-238 is an alpha-emitting heat source material which has been shown to be able to form a small critical system. The design of the reactor aspects with production-grade ^{238}Pu (80% ^{238}Pu, 16% ^{239}Pu, and 4% other plutonium isotopes) requires estimates of three unmeasured basic nuclear properties: one, the fast-neutron spectrum from the fission of ^{238}Pu; two, the average number of neutrons per fission as a function of neutron energy groups; and three, the delayed-neutron fraction in ^{238}Pu fission. Estimates based upon fission systematics give unconfirmed values of parameters which directly affect the critical size and control parameters. BIFOLD is a small, compact power source using heat pipes with thermoelectric or other energy-converting components operating in an isothermal state at its base power of 11 to 200 kW(t) or more to meet demand power needs. The split core of BIFOLD permits all operational tests to be completed economically with zero-power reactor operation which avoids induced radioactivity in components and the build-up of fission-fragment inventory. Variations in and ranges of final design parameters owing to uncertainties in nuclear data, plans for the resolution of uncertainties and the economic impact of inadequate nuclear data sources are presented. (auth)

15443 PRELIMINARY EXPERIENCES WITH ISOTOPE PACEMAKERS. Reidemeister, J. C.; Marx, E.; Schulte, H. D.; Kreuzer, H.; Gleichmann, U.; Schorn, A. (Univ., Duesseldorf). Thoraxchir. Vask. Chir.; 20: 435-440(Dec 1972). (In German).

A first report on isotope pacemakers is given. The combustion cell, thermoelectric transducer and the bipolar myocardial electrode are described in detail. Technical data concerning radiation and life expectancy are given. Surveillance of the isotope pacemaker is carried out by the well known principles of oscillographic measurements of impulse duration, and breadth and amplitude of impulse. Seven isotope pacemakers have been implanted in Duesseldorf in suitable patients up to February 1972. (auth)

Facilities and Equipment

Refer also to abstracts 15862, 15881, 16246, 16342, 17576, 17962, 18025, and 18026.

15444 (CONF-730942-P5) STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. Volume 5. Structural Analysis and Design. Part L. Heat Conduction and Thermal Stress Analysis; Inelastic Structural Behavior. Preprints of 2nd International Conference, Berlin, Germany, September 10–14, 1973. Jaeger, T. A. (comp.). (Commission of the European Communities, Brussels (Belgium); Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1973. 455p. (In English and French).

Separate abstracts were prepared for the 39 papers presented. (WHK)

For abstracts of individual papers see: 15445–15473, 16241–16248, 16342, and 17696.

15445 (CONF-730942-P5, pp vp Paper L 1/2) METHODS OF APPROXIMATE HEAT CONDUCTION ANALYSIS. Boley, B. A. (Northwestern Univ., Evanston, IL). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Many engineering situations arise in which it is desirable to use a rapid and reasonably accurate method of temperature determination. Some of these are discussed. The use of convolution techniques and of the method of images, when applied to approximate (rather than, as is usual, exact) basic solutions, is discussed. The generalization of the concept of extending approximate solutions by suitably operating on them is then investigated with the aid of examples referring to product solutions and to a nonlinear melting problem. The practicability and accuracy of this approach are assessed by means of comparisons both with known exact solutions and with other approximate ones. (auth)

15446 (CONF-730942-P5, pp vp Paper L 1/4) FINITE ELEMENT ANALYSIS OF LINEAR AND NONLINEAR HEAT TRANSFER. Wilson, E. L.; Bathe, K. J.; Peterson, F. E. (Univ. of California, Berkeley). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The finite element method is rapidly becoming a popular procedure for the evaluation of thermal stresses in complex structures. In linear analysis the method has been used extensively and has been coupled with stress analysis computer programs in order to automate thermal stress analysis. However, for the method to be effective, efficient numerical techniques need to be used. The recent developments in linear heat transfer analysis are surveyed, and the techniques that permit the practical analysis of large and complex three-dimensional heat conduction problems are presented. Typical practical problems are described and solution times are presented. In the analysis of systems with nonlinear thermal properties, the method has had limited application. The general formulation of the incremental equations used in nonlinear heat transfer analysis are presented. An efficient numerical solution of the equations is given. Several types of nonlinearities are discussed and the solutions of some typical problems are presented. (auth)

15447 (CONF-730942-P5, pp vp Paper L 1/5) CONTINUUM THEORY OF HEAT-CONDUCTION IN LAMINATES. Weng, M. T.; Koh, S. L. (Purdue Univ., Lafayette, IN). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A continuum theory is developed for the case of heat-conduction in a laminated medium composed of alternating layers of two isotropic, homogeneous materials, labelled A and B. A variational principle is first derived and later used in obtaining the necessary field equations and boundary conditions for the laminated medium. Two simple problems are considered, namely: (a) heat conduction along one in-plane direction; and (b) heat conduction in a rectangular laminated medium. It is found that the classical results are obtained in the limiting case. (WHK)

15448 (CONF-730942-P5, pp vp Paper L 2/2) ELASTO-PLASTIC THERMAL STRESSES IN PLATES WITH CIRCULAR HOLES. McCloskey, H.; Ariman, T. (Univ. of Notre Dame, IN). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Plates with holes are used extensively in nuclear reactors. These plates are subjected to thermal gradients in both the axial and radial directions. Therefore, the membrane elasto-plastic stress distribution in a finite rectangular plate with an insulated circular hole was studied. Both circular hole and outer plate boundaries are assumed to be stress free. The plate is heated uniformly through the thickness, so there are no temperature gradients outside the plane. A method of successive elastic solutions with a finite difference technique is employed. The first step in the solution of the problem is the selection of a suitable grid network. One is chosen that would guarantee points on the hole and the outer plate edges. Therefore, both Laplace's equation for the temperature field T ($\nabla^2 T = 0$), and the biharmonic equation for the stress function ϕ ($\nabla^4 \phi = 0$), have to be derived for unequal grid point spacing. This derivation is carried out using Taylor's series. Then, the particular solution of the stress function ($\nabla^2 \phi_p = -E\alpha T$), and the complementary solution of the stress function ($\nabla^4 \phi_c = 0$) are obtained for the elastic case to yield the complete solution ($\phi = \phi_p + \phi_c$). For plastic analysis, the biharmonic equation of plastic strains (ϵ_x^p, ϵ_y^p, and ϵ_{xy}^p), $\nabla^4 \phi = -E\nabla^2(\alpha T) - E[(\partial^2 \epsilon_x^p / \partial y^2) + (\partial^2 \epsilon_y^p / \partial x^2) - 2(\partial^2 \epsilon_{xy}^p / \partial x \partial y)]$, is solved by employing an experimentally determined stress-strain curve for aluminium 7075-T6. The method of successive elastic solutions using the plastic-strain-total-strain relations is employed. The numerical solution is obtained using a Gauss-Seidel program for banded matrices and the University of Notre Dame's IBM 370 computer. Extensive numerical results are presented and convergence and error of the solution are discussed. (auth)

15449 (CONF-730942-P5, pp vp Paper L 2/3) THERMAL STRESSES DUE TO UNIFORM HEAT FLOW IN THICK PLATES WITH A CIRCULAR HOLE. Lee, C. W. (Univ. of Tennessee, Knoxville). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A three-dimensional solution for the problem is obtained based on a thick plate theory (see: C. W. Lee, "Thermal Stresses in a Thick Plate," International Journal of Solids and Structures, pp. 605-615, 1970). Edge conditions at the hole are satisfied in the sense of Saint Venant, that is, stress resultants and moments are satisfied instead of stresses. The maximum stress in the present solution is found to depend on the thickness-to-radius ratio. As an alternative approach the same problem is also solved by using the method of thermal displacement potential function. In this approach a partial solution is obtained through a potential function to handle the temperature load. Another thick plate theory — L. H. Donnell, "A Theory for Thick Plates," Proc. 2nd U. S. Nat. Congress of Applied Mechanics, pp. 369-371, 1955, — is employed to give additional solution such that when superimposed to the former one all required edge conditions are satisfied. Identical results are reached from the two methods of solution. Numerical results obtained from the present solution are compared with corresponding values from the two-dimensional solution. Such comparison leads to the conclusion that the two-dimensional solution should give fairly accurate results as long as the thickness-to-radius ratio remains small. (auth)

15450 (CONF-730942-P5, pp vp Paper L 2/4) MECHANICAL ANALOGUE PROCEDURE FOR SOLUTION OF TWO-DIMENSIONAL THERMOELASTIC PROBLEMS IN MULTIPLY-CONNECTED REGIONS. Matsumoto, E.; Sekiya, T. (Osaka Univ.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An analogue procedure using electric resistance strain gauges to solve the two-dimensional thermoelastic problems for the multiply-connected regions has been previously described. The procedure used in the present paper is similar to that described in the preceding papers concerning an application of so-called "Slab Analogy" for the multiply-connected regions and makes use of the analogue between the two-dimensional thermal stress field and the curvature field for a thin plate of the same multiply-connected plane geometry in bending. The bending stresses in the plate with similar boundaries as the prototype field are measured photoelastically. Only the stresses which may be produced by the temperature distribution are treated. If there exist boundary forces and body forces in addition, the resulting stresses are obtained by superposing the stresses which are produced by the other forces to that thermal stresses. From those stresses surface strains are obtained using the constitutive equations and then strains and curvatures and twists at any point are obtained. In the case using electric resistance strain gauges, it was only possible to measure strains at points, because the electric resistance strain gauge has a finite gauge length. This method is better suited to obtain the stress pattern of the field, and then one can easily find the maximum surface stress of a bent plate. The composite plates are made by sticking together an epoxy-resin plate photoelastically sensitive and a polymethyl methacrylate plate photoelastically insensitive with epoxy-adhesive. As examples of the analogue method of the paper, the steady thermal stress distributions of symmetrical doubly-connected regions are determined and the results are compared with the values determined analytically, numerically or by means of the analogue procedure presented in preceding papers. First, the steady thermal stress field of a concentric circular cylinder is obtained by the present analogue method and the results are compared with already known analytical results. Next, as examples for complex regions the steady thermal stress fields for the polygonal regions with a circular hole at the center are obtained and those results are compared with the former numerical or experimental results by the authors. (auth)

15451 (CONF-730942-P5, pp vp Paper L 2/5) THERMAL STRESSES IN A SQUARE REGION WITH AN ELLIPTIC HOLE UNDER A HEAT GENERATION. Takeuti, Y. (Shizuoka Univ., Japan); Sumi, N.; Sugano, Y. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of determining the thermal stresses in a square region with an elliptic hole under heat generation occurs in nuclear engineering. For such problems, the use of the finite-difference or finite-element technique gives rise to a large number of linear simultaneous equations, and then the solution is very time-consuming. The analysis is developed by means of the point-matching technique in elliptic coordinates, as an extension of the five elementary function's method in plane thermoelasticity of multiply-connected region. Furthermore, it was attempted to solve the same kind of problem by use of the complex variable method. Numerical examples carried out are solutions of the problems of steady state thermal stresses in a square cylinder with an elliptic hole under constant heat generation. (auth)

15452 (CONF-730942-P5, pp vp Paper L 2/6) TRANSIENT THERMAL STRESSES IN A HOLLOW CIRCULAR CYLINDER UNDER CONTINUOUS POINT HEAT SOURCE. Takeuti, Y.; Noda, N. (Shizuoka Univ., Japan). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Exact solutions for the transient temperature distribution and the associated quasi-static thermal stresses which arise in a hollow circular disk of finite radius subjected to a continuous point heat source acting on its arbitrary point are given. Analysis is developed by the Laplace transform. The solutions are given in the form of double infinite series, and graphical representations of the solutions in dimensionless terms are included. The solutions are applicable to problems which occur in welding engineering and nuclear technology. (WHK)

15453 (CONF-730942-P5, pp vp Paper L 2/7) THERMAL BUCKLING OF TRUNCATED CONICAL SHELLS. Tani, J. (Tohoku Univ., Sendai). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A thin shell can become unstable and buckle when the thermal loading, alone or together with mechanical loads, reaches a certain amount. The stability of thermally loaded shells depends on the temperature distribution as well as on the boundary restrictions. The elastic instability of truncated conical shells subjected to axisymmetric temperature distributions is theoretically analyzed, taking into account the large deformation in the prebuckling state and the effect of temperature gradient through the thickness. The influences of initial axisymmetric imperfec-

tions and normal pressure on the critical temperature are also investigated. The conical shells of constant thickness under consideration are assumed to be isotropic and homogeneous, and their material properties are taken to be independent of temperature. The cones are considered to be perfectly clamped to the rigid end plates. The problems are analyzed for the two cases where the axial displacement at the edges is (I) constrained and (II) free. The nonlinear Donnell type basic equations are used, representing simultaneous differential equations for both the deflection and the stress function. As only axisymmetric imperfections are included in the analysis, the prebuckling deformations are axisymmetric. The nonlinear axisymmetric prebuckling problem is solved by Newton's method, in which the direct solution of the nonlinear system is replaced by the solution of a sequence of linear correctional equations. The equations needed for the solution of the buckling problem are obtained by a standard perturbation technique which leads to a linear eigenvalue problem. By means of finite differences, the equations of the prebuckling problem, as well as those of the buckling problem, are transformed into simultaneous linear algebraic equations, which are solved by Potter's algorithm (essentially Gaussian elimination) using a computer. Calculations are carried out for a wide range of geometrical parameters of the conical shell. The relations of the critical temperature to the geometrical parameters are illustrated, which facilitate the estimation of critical temperature for any given conical shell. The numerical results clearly show that the constraint for the axial displacement at the edges reduces drastically the critical temperature of clamped conical shells. Further, it is shown that the initial imperfections reduce the critical temperature, but the critical temperature is not sensitive to the initial imperfections in comparison with critical pressure. (auth)

15454 (CONF-730942-P5, pp vp Paper L 3/1) MATHEMATICAL CHARACTERIZATION OF METALLURGICAL CONDITION AND NEUTRON IRRADIATION IN STRESS-STRAIN-TEMPERATURE-TIME RELATIONSHIPS. Quaass, S. T. (Australian Atomic Energy Commission, Coogee, New South Wales). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A shortcoming in the current use of any constitutive equation for stress and failure analysis is that the material involved has to be characterized by testing before the analyst can have any confidence in the form of the constitutive equations, the values of the characteristic constants it contains, and the range of application of the equation and constants. A mathematical method of characterizing metallurgical conditions and neutron irradiation is described. It is effective for one base material but will cater for changes in solute element concentration. (WHK)

15455 (CONF-730942-P5, pp vp Paper L 4/2) INCREMENTAL THERMOMECHANICAL THEORY OF VISCOELASTOPLASTIC SOLIDS AND SOLUTION BY FINITE ELEMENTS. Chung, T. J.; Yagawa, G. (Univ. of Alabama, Huntsville). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An incremental theory of thermoviscoelastoplasticity, the finite element formulation, and an example problem is presented. An assumption of smoothness of free energy functional containing inelastic behavior with the current values of thermodynamic process taken as a "continuous functional" of past histories is considered invalid. Rather, such smoothness is assumed to be acceptable only for a small time interval. This incremental theory requires a minimum of experimental data and is quite flexible in incorporating any type of yield criterion, a classical theory of plasticity or dislocation theory. The results of an example based on the classical theory of plasticity presented appear to be reasonable although a verification by experimental data in the future is needed. (WHK)

15456 (CONF-730942-P5, pp vp Paper L 4/3) THREE-DIMENSIONAL FINITE ELEMENT METHOD OF THERMOELASTOPLASTICITY WITH CREEP EFFECT. Yagawa, G.; Ando, Y. (Tokyo Univ.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A finite element method of thermoelastoplasticity with creep effect is developed for analysing three-dimensional structures subjected to time-dependent mechanical as well as thermal loadings. The incremental stress-strain relation for thermoelastoplastic materials with creep is derived in which the Von Mises yield criterion and the associated flow rule are utilized and the creep rate is assumed to be a nonlinear function of stress, creep strain, temperature and time. The numerical solution is obtained in the incremental manner where the heat conduction equation and the incremental equation of equilibrium are solved step by step within the small time increment until the final time is reached. Mechanical or thermal loading or both can be treated simultaneously. First, nodal temperatures are calculated based on the equation of heat conduction depending on initial and boundary conditions and input data available. The temperature distribution thus obtained may then be used as input data for the calculation of nodal displacement in the equation of equilibrium. The process is repeated as far as desired. The yield conditions are checked in connection with stresses, element by element, and the plastic matrices must be constructed for the yielded elements and the creep rate is also updated at each time step. The iterative cycles are repeated until convergence is achieved within the time interval. A three-dimensional isotropic element is utilized for space domain and the difference operator for time domain where both the displacement and the temperature are assumed to be linear functions within an element and also within a time increment. The numerical integration necessary in the construction of the stiffness matrix, etc. is carried out by 8 point Gaussian quadrature. A computer program developed is capable of handling a three-dimensional solid subjected to time-dependent mechanical as well as thermal loadings. In order to verify correctness of the present approach, a comparison is made for an exact solution for a transient thermoelastic problem of a beam and an excellent agreement in the stress distribution is obtained. For demonstration, numerical examples are presented to show the creep effects superimposed on the thermoelastic and/or thermoelastoplastic solutions. An effect of geometrical nonlinearities on the solutions is also discussed. (auth)

15457 (CONF-730942-P5, pp vp Paper L 4/6) BOUNDING CREEP SOLUTIONS FOR A STRESSED PLATE SUBJECTED TO VARIABLE SURFACE TEMPERATURE. Ponter, A. R. S.; Leckie, F. A. (Univ. of Leicester, Eng.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Methods for the analysis of structures which are subjected to both variable thermal and mechanical loading and which suffer creep and plastic deformation have been devised. It is demonstrated how the theory can be applied to determine bounds on creep deformations of a uniform plate subjected to constant average in-plane stress and a fluctuating temperature through its thickness. The material is described by a non-linear Maxwell law with an activation energy temperature dependence. The effects of variable temperature on material and thermal expansion are included in the problem. Two solutions are computed which provide bounding solutions in a certain defined sense and correspond to the actual solution when the time scale of temperature fluctuations is either long or short compared with the characteristic time scale of the material. These bounding solutions are easily calculated and provide considerable insight into the ratchetting mechanisms which can occur. It is found that the effects of thermal expansion can considerably increase the rate of deformation of the plate, but that the effect of thermal softening of the material can reduce this effect considerably. Thus, in any analysis, both phenomena must be realistically included, and ignoring the effect of temperature and material behavior will provide excessively pessimistic results. The calculations described provide the first step towards an understanding of the effects of variable temperature on creeping structures and indicate that comparatively simple calculations may provide the most relevant design information. (auth)

15458 (CONF-730942-P5, pp vp Paper L 5/4) SOME OBSERVATIONS ON CREEP BUCKLING ANALYSIS. Hayman, B. (Univ. of Leicester, Eng.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Analytical studies are made of some simple model structures which contain nonlinear viscoelastic elements representing the effects of elasticity and steady-state metallic creep. The models have been chosen by virtue of their elastic postbuckling behavior: one type has the stable elastic postbuckling response typical of columns, while another has the unstable type of postbuckling exhibited, for example, by certain shell structures. The simplicity of the models enables exact large deflection calculations to be made for both instantaneous elastic and time-dependent creep conditions, thus permitting a ready demonstration of the phenomena encountered. Analyses of the more familiar small-deflection type are also performed for comparison. Effects of changing such parameters as the creep index n and load level P are readily examined, as is the dependence on the size of the initial imperfection which, by its growth, leads to creep buckling. The large deflection analyses indicate that the creep behaviour of the structures studied is intimately connected with the elastic postbuckling behavior. For example, true constant-load creep instability characterized by infinite deflection rate at finite (critical) time and finite displacement is seen to occur only with structures with unstable elastic postbuckling. (The column is

outside this category.) It is widely known that small deflection analyses of purely elastic structures predict the growth of infinitely large deflections as P approaches the elastic critical load P_e, regardless of the true postbuckling behavior. Thus, at given load, safe estimates of deflections tend to be obtained for structures with stable postbuckling and unsafe estimates for those with unstable postbuckling. Corresponding features are observed in small deflection analyses of the models under creep conditions: if elastic postbuckling is stable the deflections after a given time are overestimated, but if elastic postbuckling is unstable they are underestimated, the critical time being also an unsafe estimate in this latter case. It is found that in either case the degree of approximation in the small deflection analysis is very small provided: (a) n is somewhat greater than unity (as it generally is), (b) the imperfection is not too large, and (c) P is not too close to P_e. The range of admissible imperfection sizes and load levels is smaller for structures with unstable postbuckling, but these two parameters would in any case be severely restricted in the design of a practical structure on account of imperfection sensitivity in the purely elastic behavior. Thus a small deflection creep buckling analysis is likely to be adequate provided the requirements for safe elastic behavior are met. Some discussion is included of the effects of instantaneous plastic strains. A brief survey is made of possible methods of estimating the critical time using as far as possible information gained from analysis of the instantaneous response of the structure. (auth)

15459 (CONF-730942-P5, pp vp Paper L 5/5) NONLINEAR EFFECTS OF HIGH TEMPERATURE ON THE VIBRATION OF A SIMPLY SUPPORTED BEAM WITH A CENTRAL MASS BY MATHEMATICAL PROGRAMMING TECHNIQUE. Iyengar, N. G. R.; Murthy, P. N. (Indian Inst. of Tech., Kanpur). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of free vibration of a simply supported beam with a central mass and undergoing small oscillations was analyzed by using mathematical programming techniques based on the principle of minimum strain energy. The problem was formulated in terms of the Lagrangian. Convergence studies were made by taking a number of beam segments. Results indicate that the frequency decreases with an increase in amplitude and with an increase of mass ratio. (WHK)

15460 (CONF-730942-P5, pp vp Paper L 5/6) NONLINEAR EFFECTS OF HIGH TEMPERATURE ON THE VIBRATION OF BEAMS WITH TIME DEPENDENT BOUNDARY CONDITIONS. Aravamudan, K. S. (Massachusetts Inst. of Tech., Cambridge); Murthy, P. N.; Iyengar, N. G. R. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The influence of non-linear material properties on the dynamic response of beams whose boundaries are constrained to undergo displacements which are varying with time was studied. The governing equation was formulated, and solutions were obtained by the perturbation method in conjunction with a finite transform technique and Galerkin's method associated with a transformation suggested by Mindlin and Berry. Response curves were obtained for different boundary conditions for various values of boundary displacements. (WHK)

15461 (CONF-730942-P5, pp vp Paper L 6/2) PLASTIC ANALYSIS OF SHELLS BY FINITE ELEMENTS METHODS. Global Plasticity Model for Any Shapes of Shells. Hoffmann, A.; Livolant, M.; Roche, R. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of thin shell plasticity can be approached in two ways. The first consists in retaining the strain-displacement relations particular to shells (the normal stays normal) and to consider the stress-strain relations at each point of thickness. This method, as concerns stresses, leads to the elaboration of a three-dimensional formalism. Despite its apparent severity this formula is very questionable, since it is assumed that the material of the shell is homogeneous and isotropic. Such assumption is seldom borne out in engineering. The characteristics of the metal in the normal way are very different from the others and they all vary in thickness. It therefore seems better to consider the shell element as typical and to define its properties at one stroke. This is the origin of the second method which is presented. This method, more comprehensive, consists in considering all the stresses acting on the component, the tensions: $N_i = \int \sigma_i dz$, the moments: $M_i = \int \sigma_i dz$, and to attempt to express the flow laws in terms of these six comprehensive variables. It is shown that such a model is possible and leads to considerable simplification in the calculations. The strains of the mean surface, e_i, and the curvatures χ_i are respectively associated to the tensions and moments. The work is expressed as $dW = N_i de_i + M_i d\chi_i$. The state of plasticity is characterised by a general law: $\Phi(N_1N_2N_3M_1M_2M_3, \text{hidden variables}) = 0$. It was attempted to have a model as isotropic as possible but moments and stresses are seen to be inhomogeneous. It is necessary to introduce two variables M^* and N^* characterising the state of the material. These variables should enable M_i and N_i to be normed. A form can then be suggested for the boundary indicated by $F(n_i, m_i, \alpha) = 0$, $n_i = N_i/N^*$, $m_i = M_i/M^*$, and $\alpha = \alpha(M_*^*/hN^*)$ where h is the thickness, F homogeneous and of the first degree in relation to n_i and m_i. Such models have been used in POCO system, and the results have been successful. Indications are given on the formulation, and on the results with reference to experimental data. (auth)

15462 (CONF-730942-P5, pp vp Paper L 6/4) CREEP BEHAVIOR OF SPHERE-CYLINDER SHELL INTERSECTIONS SUBJECTED TO INTERNAL PRESSURE. Leckie, F. A.; Hayhurst, D. R.; Morrison, C. J. (Univ. of Leicester, Eng.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The results of approximate bounding methods of estimating creep deformation and rupture life are presented and applied to the case of a sphere-cylinder shell intersection subjected to internal pressure. The approximate methods for both deformation and rupture are derived in terms of the structural collapse state and the associated stress distribution, so that with little modification, concepts already familiar to designers, can be applied to structures operating in the creep range. Both the deformation and rupture procedures are expressed in terms of a normalised representative stress which is found to be insensitive to the form of the constitutive and material damage laws; the structural performance is determined from a single set of uniaxial deformation and rupture tests. Since the rupture times obtained using this method recognise the stress redistribution effects due to material rupture damage, the results are less conservative than those obtained from standard procedures and are obtained with considerably less effort. The A.S.M.E. and British Standards Pressure Vessel Codes are discussed in the light of the theoretical predictions and it is shown that for the majority of materials and shell structures the limiting criterion is deformation rather than rupture. Predicted deformations are shown to agree well with the results of tests carried out on sphere-cylinder shell intersections subjected to internal pressure which were machined from R. R. 58 aluminium alloy and tested at 200 ± ½°C. The test results show that the deformation of the membrane region of the shell is the limiting design criterion. (auth)

15463 (CONF-730942-P5, pp vp Paper L 6/5) LARGE CREEP DEFORMATIONS OF THIN SHELLS OF REVOLUTION. Takezono, S.; Nakatsukasa, M. (Kumamoto Univ., Japan). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The numerical analysis of large creep deformations of thin shells of revolution under an axi-symmetric load with applications to metallic bellows is studied. There are many investigations on the creep problem of shells of revolution because it is closely related to the analysis and the design of pressure vessels and pressure vessel components used in high temperature. These investigations, however, are almost all based on the small deflection theory. But since deformations of thin shells under creep conditions usually become considerably large, the development of methods taking into account geometrical nonlinearity is required. The mathematical theory of creep as it applies to thin shells of revolution undergoing considerably large deformations is developed for two hardening laws: the time hardening law and the strain hardening law. The basic differential equations derived for incremental values with respect to time or load are numerically solved by a finite difference method, and the solutions at any time are obtained by integration of the incremental values. The computer programs for two hardening laws are developed. As a numerical example the problem of creep deformation of metallic bellows important in practical use is treated. For the elastic solution from this method the validity is confirmed by comparing with the solution from a finite deformation theory which has been studied by other authors. It is shown that in creep deformation of thin shells as bellows, the difference between solutions from linear theory and those from non-linear theory becomes large, therefore the non-linear theory should be employed. The analysis of shells in steady creep becomes a subcase of the more general transient creep process described here. (auth)

15464 (CONF-730942-P5, pp vp Paper L 6/6) INELASTIC ASYMMETRIC BUCKLING OF RING-STIFFENED CYLINDRICAL

SHELLS UNDER EXTERNAL PRESSURE. Lee, L. H. N. (Univ. of Notre Dame, IN). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A new analysis on the effects of prebuckling deformation on the inelastic asymmetric buckling of a ring-stiffened cylindrical shell under external pressure is made. The shell is made of a work hardening material having incremental type constitutive relationships and a yield surface with vertices of varying sizes. A variational principle involving Kirchhoff stress rates and velocity fields in Lagrangian descriptions is employed to solve the problem. The variational principle in conjunction with the Rayleigh-Ritz method is used to determine the prebuckling axi-symmetrical deformation caused by the pressure and the fixed edges at the ends and rings. The pressure is normal to the deformed surface. A layered shell idealization and an incremental procedure are used to determine the non-linear deformation process. For each pressure increment, the condition for asymmetric bifurcation is evaluated until the critical pressure is reached. A comparison of the theoretical predictions obtained numerically by an IBM 370 computer with available experimental results is made. The numerical results indicate a significant fact that the buckling pressure is sensitive to the size of the vertices of the yield surface. Good agreements between the numerical and experimental results are found. (WHK)

15465 (CONF-730942-P5, pp vp Paper L 6/7) BUCKLING OF VISCOPLASTIC CYLINDRICAL SHELLS SUBJECTED TO RADIAL IMPULSE AND TEMPERATURE. Wojewodzki, W. (Politechnika Warszawska, Warsaw). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of buckling of a thin viscoplastic cylindrical shell is solved by means of the kinetic method. The shell is loaded by a radial pressure impulse and is subjected to a given temperature. The possibility of obtaining plastic solutions treated as a limiting case of solutions concerning viscoplastic materials is shown. The viscosity of the material is found to increase the response of the shell to buckling, whereas the imperfections, nonuniform loading, and elevated temperature decrease its buckling resistance. (WHK)

15466 (CONF-730942-P5, pp vp Paper L 7/2) LINEAR PROGRAMMING APPROACH TO SHAKEDOWN ANALYSIS OF STRUCTURES. Corradi, L.; Zavelani Ross, A. (Politecnico, Milan). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In general terms, an elastic perfectly plastic structure is said to shake down under loads varying within a given domain (whose amplitude is defined by a multiplier s) if plastic flow eventually ceases, i.e., if after a certain time the response to further loading (within the domain) is purely elastic. According to Bleich and Melan's classical theorem a structure will shake down if self-stresses can be found which lead, when superposed to the elastic response to any load in the domain, to a stress state that nowhere exceeds the yield limits. The analytical evaluation of the stress field is difficult and can be performed only for discrete or simple continuous structures. However the above definition spontaneously suggests numerical methods based on mathematical optimization techniques. A theory, based on finite element discretization, that in principle permits the evaluation of the shakedown load for a general continuum was proposed by Maier: if the material yield condition is piecewise linearized, a solution can be obtained corresponding to the optimal value of a linear programming problem. At the present stage, the only numerical solution so far obtained for a problem whose analytical solution is not available was given by Belytschko, who found a lower bound to s for a plane stress problem, using an equilibrated finite element model and nonlinear mathematical programming techniques. A procedure is proposed which reduces drastically the number of constraints in Maier's approach while retaining the linear nature of the problem. The method is conceptually analogous to a procedure that already proved successful in limit analysis. Depending on the finite element model adopted, values that reasonably can be conceived as lower bounds to s can be obtained, as well as upper bounds. Some numerical results are also shown, from which the effectiveness of the method can be deduced. (auth)

15467 (CONF-730942-P5, pp vp Paper L 7/3) DEFLECTION BOUNDING AT SHAKEDOWN UNDER THERMAL AND MECHANICAL LOADINGS. Koenig, J. A. (Inst. of Fundamental Technical Research, Warsaw). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Some elements of nuclear reactors are subjected to cycles of both temperature variation as well as to cycles of repeated variable pressure of liquid and/or gas. The theory of shakedown is appropriate in such cases to estimate the structural safety of a structure under consideration. However, fundamental theorems of the theory are based on the assumption of geometric linearity. Moreover they do not provide any direct bounds to maximum strains and displacements which may occur during an arbitrary long period of service of the structure, even if shakedown is ensured. Only recently some results have been obtained in this field. The main idea of those estimates is the following. The total displacement u in an elastic-plastic body is a sum of "elastic" displacement u^E calculated for unlimited elastic response and an additional "plastic" term u^P. The term u^E is a linear form of load parameters and the term u^P can be presented as a linear functional of plastic strain field ϵ^P. The constraints of the problem are as follows: (1) limits of variations of loads (limits for load parameters); (2) yield condition; and (3) maximum value of the total energy dissipated in a shakedown process. The constraints (2) and (3) can be presented as some functional inequalities for the load parameters and plastic strains. In this way the problem of maximum (minimum) of the displacement at a given point of the body becomes a problem of optimal control. If the structure is described in a discrete manner one obtains then a problem of mathematical programming. This problem can be linearized, e.g., by means of linearization of the yield condition. Some of those methods are extended to the case of thermal effects by including an additional term of thermal strains. A numerical example of a circular thick-walled tube is presented. An upper bound is established for maximum radial displacement occurring when internal pressure and temperature vary arbitrarily within some prescribed limits. Some conclusions concerning limits of validity of the theory of shakedown are given. (auth)

15468 (CONF-730942-P5, pp vp Paper L 7/4) BOUNDS TO PLASTIC STRAINS AND DISPLACEMENTS IN DYNAMIC SHAKEDOWN OF WORKHARDENING STRUCTURES. Maier, G.; Vitiello, E. (Politecnico, Milan). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Various methods are proposed for the determination of upper and lower bounds on the values that plastic displacements, plastic strain components and other linear or non-linear functions of the plastic multipliers, eventually attain when an elastic work-hardening system shakes down under periodic external actions (loads and dislocations) in the presence of significant dynamic effects. All procedures proposed presume merely the linear elastic dynamic analysis of a fictitious structure and are amenable to well-known numerical techniques in mathematical programming (linear, quadratic, or nonlinear). This circumstance, which confers an operative value to the theory developed, rests on the assumed discretization of the structures, piecewise linearization of the yield loci and of the hardening rules. It would be worthwhile, particularly from the theoretical standpoint, to remove the restrictions and tackle the same problem by a broader approach. The simple illustrative example included seems to indicate that fairly stringent and, hence, useful upper bounds can be achieved with a reasonable amount of calculations (and far smaller than that required by the otherwise inevitable evolutive study of the whole plastodynamic response). (WHK)

15469 (CONF-730942-P5, pp vp Paper L 7/5) INADAPTATION THEOREM IN THE DYNAMICS OF ELASTIC-WORKHARDENING STRUCTURES. Corradi, L.; Maier, G. (Politecnico, Milan). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

This study concerns elastic perfectly plastic and elastic strain hardening structures subjected to a given history of external agencies (loads and imposed strains or displacements) whose variation is not slow so that inertia and damping effects cannot be neglected. Displacements are supposed to be small enough for the usual first order theory to be applied. The structures considered are made discrete and the material constitutive laws are piecewise linearized. Some broad classes of discrete structural models, piecewise linear yield loci and hardening rules are allowed for. In this way the dynamic elasto-plastic response of the structure to the assigned external agencies may be studied on the basis of a convenient matrix description. A number of results concerning the dynamic behavior of plastic structures have been previously reached making use of these assumptions: Ceradini's dynamic shakedown theorem was extended to strain hardening structures, allowing for a fairly large class of hardening rules; the problem of finding the maximum load multiplier for which shakedown occurs was formulated as a linear programming problem. A necessary and sufficient condition for inadaptation is stated and proved, inadaptation meaning that the plastic work, and, hence, some plastic deformations, increase unlimitedly in time (i.e., the structure does not shakedown). This condition may be considered as the extension to the dynamic range of the second (Koiter's) shakedown theorem of classical plasticity,

to which it reduces when the variation of external agencies is slow. In the same sense Ceradini's theorem can be regarded as an extension of classical Bleich-Melan's theorem. The proof of the theorem makes use of the aforementioned linear programming formulation of the dynamic shakedown analysis and flows from considerations pertaining to the mechanical nature of the problem and from concepts belonging to mathematical optimization theory. It is reasonable to expect that the use of the generalized inadaptation theorem in dynamics is as effective as to the use of Koiter's theorem in statics. (auth)

15470 (CONF-730942-P5, pp vp Paper L 7/7) THERMO-ELASTO-PLASTIC CYCLIC ANALYSIS BY FINITE ELEMENT METHOD. Gerij, J. (Societe pour l'Industrie Atomique, Courbevoie, and Technicatome, Gif-sur-Yvette, France). 1973. (In French).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Actually for the checking of the resistance of a nuclear reactor structure, the ASME Code may require a complete analysis of inelastic deformations. The THEPLA program of tridimensional cyclic thermo-elasto-plasticity using the method of finite elements allows the computing, for the first cycles, the instantaneous elasto-plastic deformations, the creep and the stress relaxation. The main computation analyses are: isotropic material; incremental infinitesimal theory of plasticity; small deformations; Bauschinger's ideal and isotropic effect; mechanical properties of the material unique function in the temperature-deformation-stress space; Young's modulus independent of the hardening; and the quasi-static variation of the load. The properties of the material varying with the temperature and measured on mono-dimensional samples are used without any simplification. The overall deformation is the sum of the elastic, plastic, creep and thermal deformations and those due to the variation with temperature of the Young's modulus and Poisson's ratio. Examples are shown and the plastic behavior of the structures is discussed. (auth)

15471 (CONF-730942-P5, pp vp Paper L 7/8) DESIGN METHODS FOR DUCTILE STRUCTURES SUBJECTED TO RELATIVELY LARGE CYCLIC DEFORMATIONS. Krishnasamy, S. (Ontario Hydro, Toronto); Sherbourne, A. N. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In classical design methods based upon elastic analysis, the load at which first yield occurs in a structure is usually considered as its limiting strength. It has been proven, however, that structural systems made of ductile materials possess considerable reserve strength even after the yield limit has been reached. This is due to the plasticity of the material which allows a favorable redistribution of stress in the structure. Simple plastic theory, which utilizes the ductility of materials, is essentially based upon the concept of a set of proportional loads which affect the collapse of a structure. It has also been established that a structure may fail under suitably varying or cyclic loading conditions even though the load is less than the plastic collapse value. The cyclic loading may cause the structure to fail either by "incremental collapse" or "alternating plasticity". In reality, cyclic loading is random in nature and is not necessarily always well defined. It may be possible, with the help of modern testing and computing techniques, to study the behavior of a specific structural system under a given loading condition; an understanding of the basic response of structural elements is, however, essential for the development of a more general theory. An attempt is here made to develop such a design method for simple structural components under well defined cyclic loads; it might be possible to apply the method for more general loading conditions based upon this study of simple structural elements. In these circumstances cyclic loading can be divided into two cases involving: (i) deflection control and (ii) load control. Each case, in turn, can be further classified into three categories covering (a) full reversal (b) repeated and (c) partial reversal. A study of the behavior of structural components under deflection control is presented. Results from tests on beams under pure bending are employed to predict the deformation response and life of simple structural components (cantilever beams). The predictions are compared with experiments. The performance of cantilever beams under each of the above mentioned categories of loading is also discussed. Design charts are prepared for simple beams under various combinations of cyclic loading. (auth)

15472 (CONF-730942-P5, pp vp Paper L 8/2) ASSESSING NOTCH STRENGTH REDUCTION IN CYCLICALLY LOADED NOTCHED COMPONENTS. Leis, B. N.; Topper, T. H. (Univ. of Waterloo, Ont.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The decreased severity of notches in fatigue as compared to the severity predicted by deformation analysis in terms of a number of factors which may influence this behavior is examined. These factors include plasticity, the failure criterion selected for smooth and notched samples and the local stress state in the notched sample. The failure criterion selected was found to have a marked influence on the value of K_f (fatigue concentration factor) at all fatigue lives while, as expected, plasticity was important only in the low and intermediate life regimes. Experimental results indicated that the deformation analyses employed did not adequately predict the inelastic deformation behavior at the notch root. To account for this behavior a correction factor for plasticity, which is a function of the nominal stress and the material deformation behavior, determined from a recent deformation analysis and substantiated by measured values of notch root strain is proposed. A solution for local biaxial stresses and a biaxial fatigue criterion was used to predict the variation of the fatigue concentration factor with thickness in plate specimens. Agreement of these predictions with experimental results was excellent. (66 references) (auth)

15473 (CONF-730942-P5, pp vp Paper L 8/5) EXPERIMENTAL MEASUREMENT OF CREEP RELAXATION IN CYLINDRICAL METAL POWER PLANT COMPONENTS UNDER CYCLIC THERMAL LOADING. Torr, K. G.; Head, J. L. (Imperial Coll. of Science and Tech., London). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Several computer codes have been developed which predict the stress and strain history in a component subjected to any prescribed loading sequence, taking account of plastic and creep strains. One such code, PLAST, has been developed at Imperial College to perform a one-dimensional analysis of a thick-walled cylindrical component under axi-symmetric loading, in a state of generalised plane strain. This code has been checked against earlier experimental and analytical solutions only for certain loading cases, and it is important that the code should calculate transient creep strains correctly if the life of a component is to be predicted reliably. The object of the work described is to test experimentally the code predictions of transient creep in a thick-walled cylinder. This is done by measuring experimentally the residual stress pattern in a cylinder which has been subjected to a load sequence during which transient creep is expected to occur, and compared with that predicted by the code. For simplicity, the loading is obtained by inducing a radial heat flux in the wall of the cylinder by positioning an electrical resistance heater centrally in the bore of the cylinder within a specially built furnace. This is the only form of loading employed in the tests. The selected test specimen is a cylinder of 75 mm outside diameter, 25 mm bore and 150 mm length and the material used in these tests is Nimonic 80A extruded bar. Measurement of the residual stress distribution is by the well known method due to Sachs. To reduce induced stresses on layer removal, a method by chemical milling has been devised, in preference to lathe turning, and the resulting strain changes on the bore surface are measured by means of foil strain gauges. It is intended to increase the scope of the investigation by building a second rig in which additional forms of loading may be applied to the component (e.g. pressure) to study further the cyclic accumulation of strain. It is probable that this will not be confined to thick cylinders and Nimonic material, with a view to Fast Reactor structures. (auth)

15474 (JUL-990-RG) GESIT: A THERMODYNAMIC PROGRAM FOR SINGLE CYCLE GAS TURBINE PLANTS WITH AND WITHOUT INTERCOOLERS. Heil, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Aug 1973. 41p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

A computer program for the thermodynamic modeling of single-cycle gas turbine plants is described. A high-temperature reactor is assumed as a heat source in the program, but the HTR can be replaced with another heat source without difficulty. Starting from a set of independent data, the program calculates efficiencies and mass flows. It indicates all values for a heat and power balance and prints out the temperatures and pressures for the different parts of the cycle. Besides this, the program is able to optimize the compression ratios for minimal power input. It also takes into account turbine rotor cooling (at the roots of the blades). Furthermore, the program is able to use either total pressure loss or specified losses in different parts of the cycle. The program GESIT can also handle systems with one or two intercoolers, or with no intercooler. GESIT gives all input and output values for the heat exchangers and turbo-machines. First the single-cycle gas turbine plant is described. After that the computational basis for the program and the program structure is explained. Instructions for data input are given so that the program can be immediately utilized. An example of input data together with the associated output is presented. (auth)

15475 (LA-5459-SR) RAPID EXCAVATION BY ROCK MELTING. LASL Subterrene Program, December 31, 1972 – September 1, 1973. Hanold, R. J. (Comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 38p. Dep. NTIS $4.00.

Research is continuing on establishing the technical and economic feasibility of excavation systems based upon the rock-melting (Subterrene) concept. A series of electrically powered, small-diameter prototype melting penetrators have been developed and tested. Research activities include optimizing penetrator configurations, designing high-performance heater systems, and improving refractory-metals technology. The properties of the glass linings that are automatically formed on the melted holes are being investigated for a wide variety of rocks and soils. Thermal and fluid-mechanics analyses of the melt flows are being conducted with the objective of optimizing penetrator designs. Initial economic models of the rock-melting concept extended to large tunnelers are being developed. Field tests and demonstrations of the prototype devices continue to be performed in a wide range of rock and soil types. The conceptual design of the electrically powered, self-propelled, remotely guided, horizontal tunnel-alignment prospecting system (Geoprospector) has been initiated. Such a device will also find applications in energy transmission, i.e., utility and pipeline installations. The long-term goal of the research is to develop the technology and prototype hardware that will ultimately lead to large tunneling devices, with improved advance rates and reduced tunnel project costs. The rock-melting concept includes elements that will result in innovative solutions to the three major functional areas of tunneling: rock disintegration, materials handling, and hole-support linings. The proposed excavation method, which is relatively insensitive to variations in rock formation, produces a liquid melt that can be chilled to a glass and formed into a dense, strong, firmly attached hole lining. Unique applications to large automated tunneling systems, ultradeep coring for geoscience research, and hot-rock penetration for geothermal energy development are being investigated. (auth)

15476 (LMEC-TDR-73-9(Add.)) EVALUATION OF HEATER CIRCUIT PROTECTIVE DEVICES AS A MEANS OF LIMITING HEATER FAILURE DAMAGE. Davis, K. A.; Fischer, B. E.; Schlowitz, H. H. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 15 Nov 1973. Contract AT(04-3)-700. 111p. AT.

A description of additional testing done on tubular electrical resistance heaters and the results of the tests performed at the Liquid Metal Engineering Center are presented. The tests were designed to: (1) determine the effect of a standoff heater mounting configuration on heater sheath temperature in both a horizontal and vertical position; (2) determine the relationship between ground fault interruption (GFI) circuit tripping current and GFI tripping delay time; and (3) determine the effect of temperatures from 500 to 1600°F on tubular electrical resistance heater element resistance, insulation resistance, and dielectric breakdown voltage. (auth)

15477 COMPUTER ASSISTED RADIATION THERAPY MACHINE. Pavkovich, J. M. (to Varian Associates). US Patent 3,783,251. 1 Jan 1974. Filed Date 27 Nov 1970. 10p.

A radiotherapy machine that includes a rotatable gantry having a radiation source portion which is rotatable about a patient treatment couch is described. Geometric and dose parameters of the machine for defining a prescribed treatment plan of radiation are stored in the memory of the computer. A readout and display means is provided for displaying the geometric and dose parameters of the defined radiation treatment plan. Editing and updating capability are provided for editing and updating the treatment plan with the cumulative radiation dose administered to each portal and the total cumulative dose administered to the patient. Each parameter of a proposed treatment plan is compared with permissible ranges of machine parameters stored in a memory to verify that the proposed treatment is within the permissible range of the machine. (Official Gazette)

15478 BETA-IRRADIATION APPARATUS. Mamin, E. B.; Makarov, V. A.; Korneeva, G. P.; Poppel, B. S.; Ivanov, V. I. US Patent 3,784,825. 8 Jan 1974. Filed Date 18 Nov 1970. 4p.

A beta-irradiation apparatus in which an irradiator is divided into at least two compartments which accommodate holders each of which is filled with a substance containing a beta-emitting radioisotope enclosed in a plurality of separate hermetic capsules arranged in a matrix is described. The holders in the compartments and the capsules in the holders are disposed so that by a suitable arrangement of the capsules, the desired intensity and geometry of the beta-radiation field is secured. (Official Gazette)

15479 FACILITIES REQUIRED FOR RADIOSTERILIZATION. Jefferson, S. pp 89-94 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

The first step in planning facilities for radiosterilization is to decide on the scale of operation i.e., experimental, pilot, or full production. The possibility of starting in one category and moving towards larger scale work by modification and addition is discussed. (auth)

15480 ORGANIZATION OF INDUSTRIAL AND MEDICAL CENTRES FOR RADIOSTERILIZATION. Jefferson, S. pp 95-97 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

The planning and construction of an industrial or medical radiosterilization plant in respect to location, cost, safety, and quantity of materials to be irradiated are discussed. (TFD)

15481 SAFETY RULES. Jefferson, S. pp 163-166 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Safety procedures and methods to be followed in the operation of a radiosterilization plant are reviewed. (TFD)

15482 ECONOMICS OF RADIOSTERILIZATION. Jefferson, S. pp 167-168 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

An installation for radiosterilization of medical supplies using either electrons or γ radiation can only become competitive economically when operated on a large scale because the minimum capital investment is usually in excess of $250,000. There have been many theoretical comparisons of the economics of electron machines and γ radiation plants, which tend to indicate that for a power level of 12 kilowatts (about 800,000 curies of ^{60}Co) the two systems are similar. Below this power rating cobalt appears cheaper and above the turnover point the electron process is cheaper in terms of weight of product treated. However, there are many practical points that invalidate the above conclusion and make the turnover point more than 50% higher and even that is open to debate. These points are discussed with emphasis being placed on labor and reliability. From these standpoints it is concluded that a gamma facility is more economical. (TFD)

15483 HEAT PIPES. I. Operation and Characteristics. Asselman, G. A. A.; Green, D. B. (Philips Research Labs., Eindhoven, Netherlands). Philips Tech. Rev.; 33: No. 4, 104-113 (1973).

Heat-transport problems in nuclear reactors and in space applications have in recent years stimulated intensive research in many countries on a heat-transport method whose principle has long been known, the method of transporting heat in its latent form, i.e., the latent heat of vaporization. Heat conductors based on this principle, called "heat pipes," can have a thermal resistance more than 10,000 times smaller than that of a copper rod of the same dimensions. Heat pipes are of considerable interest for heat transport for Stirling engines and the development of isothermal ovens. The design and operating characteristics of heat pipes are discussed. (auth)

15484 ELECTROSTATIC PRECIPITATOR (7 Mar 1968) (Engineering Materials). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE-2375).

34 drawings.

The scrubber-precipitator systems in use in the dissolution facility were designed to remove acid fumes generated during mineral dissolution operations from an air stream. Normally encountered in the operations are relatively hot fumes of HF, HCl, decomposition products of HNO_3, and $HCLO_4$. The removal is effected in two stages: Wet-scrubber Stage— This stage consists of a conventional Burl saddle packed wet-column scrubber through which a 2N NaOH solution is circulated from a chilled (~16°C) sump. Normal engineering design parameters for packed column scrubbers were used. This stage is 98+% effective in removing all fumes of concern except $HClO_4$. Hot $HClO_4$ fumes upon introduction to any wet scrubber system of reasonable size present a special problem; only 60 – 80% is removed by scrubbing. The remainder passes through as a fine $HClO_4 - H_2O$ aerosol which is difficult to trap. Precipitator Stage— The electrostatic precipitator stage was designed to remove the $HClO_4$ – aerosol from the air stream. A platinum wire center cathode is suspended within a cylinder anode and a field of 30 KU half-wave rectified dc is applied. The corona discharge from the fine Pt cathode discharges the aerosol particles which are subsequently swept to the anodic walls and collected in a sump. The efficiency of collection is 96+% (limit of testing procedure). (auth)

15485 COLLECTION EFFICIENCY OF AIR SAMPLING FILTER PAPERS FOR POLYSTYRENE LATEX AEROSOLS. Ikezawa, Y. (Japan Atomic Energy Research Inst., Tokai, Japan); Murata, M.; Ohata, T.; Yoshida, Y.; Matsumoto, M. Hoken Butsuri; 8: No. 3, 145-152(Sep 1973). (In Japanese).

The collection efficiency of nine types of filter papers for air sampling was determined for monodispersed polystyrene latex aerosols by using a forward light scattering photometer. The aerosols were 0.091, 0.198, 0.365, 0.500 and 1.099 μm in dia., which flowed through a test filter paper at a face velocity from 4.2 to 200 cm/sec. Toyo No. 660, No. 60 and No. LP filter papers exhibited minimum efficiencies at the face velocity range between 10 and 80 cm/sec, and in the particle size range between 0.1 and 0.5 μm. The collection efficiencies of Toyo No. 5A and Whatman No. 41 filter papers were over 95% for all the particle sizes at a face velocity higher than 100 cm/sec. Toyo HE-40, HV-70, Toyo GB-100 and Gelman E filter papers showed collection efficiencies higher than 99%. The theoretical filter efficiency based on single fiber filtering mechanisms and the effect of neighboring fiber interference on the collection efficiency are also discussed. (auth)

15486 POLLAK COUNTER USE IN THE MEASUREMENT OF NUCLEAR PLANT ABSOLUTE FILTER EFFICIENCY. Kunz, P.; Muzzi, F. (Istituto d'Impianti Nucleari, Pisa, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 1, 20-30(1972). (In Italian).

A new method for the determination of HEPA particle filter efficiency using a Pollak counter is described. This instrument greatly simplifies the problems arising from in situ measurement, and the method itself is free of some of the limits to which existing methods are subject. The present research was carried out as part of a combined program by the University of Pisa's Nuclear Plant Department and the CNEN's Safety and Control Division. (auth)

15487 SELECTOR VALVE APPARATUS FOR SAMPLING FLUID FROM A NUMBER OF PIPES. Hosegood, S. B. (to United Kingdom Atomic Energy Authority). British Patent 1,334,431. 17 Oct 1973. Filed date 5 May 1971. 4p.

A gas sampling apparatus for the selective sampling of a number of gas streams or at a number of points in a single gas stream, and which may have application to gas cooled nuclear reactors, is described. The apparatus includes a multiport sampling valve for connecting the gas sampling lines individually to a single gas sampling location. A gas-tight casing is arranged to be supplied with clean gas at a pressure higher than that in any of the sampling lines, and a fixed plate is provided having a number of parts arranged to be connected to the gas sampling lines, with a rotatable plate mounted in contact with the fixed plate and having a port arranged to be selectively registered with any port in the fixed plate. Operation may be remotely controlled. (UK)

15488 SYSTEM EMPLOYING TWO PAIRED AND AUTOMATED POLLAK COUNTERS FOR MEASURING THE EFFICIENCY OF ABSOLUTE FILTERS. Cagnetti, P.; Rossi, M. (CSN, Casaccia, Italy). G. Fis. Sanit. Prot. Radiaz.; 18: No. 2, 88-100(1972). (In Italian).

The photoelectric counter of condensation nuclei (Pollak counter) has been widely used as an instrument for the in situ measurement of the efficiency of filters. An automated apparatus consisting of an upstream and a downstream Pollak counter is described. Easily transportable, this apparatus can rapidly and accurately measure nuclei concentrations and assess filter efficiency. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 15445–15447, 15483, 17556, 17571, 17572, and 17696.

15489 (EIR-241) HEAT TRANSFER TO FLOWING SODIUM. Theoretical and Experimental Investigations on Temperature Profiles and Turbulent Temperature Fluctuations in a Tube. Fuchs, H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Aug 1973. 389p. (In Swedish and English). Dep. NTIS (U. S. Sales Only) $21.50.

Heat transfer theories for liquid metals are mostly based on velocity data. Temperature distributions are derived by means of the eddy diffusivity concept. A number of theories are critically reviewed; the two principal areas of uncertainty are identified as: (1) choice of appropriate velocity data (inaccurate velocity profiles are the reason for the high Nusselt values which the famous Lyon-Martinelli formula yields), and (2) choice of realistic eddy diffusivity ratios. Point 1 does not necessarily require liquid metal experiments, but point 2 does. A review of pertinent experimental data shows that reliable data for sodium is rather scarce. Measurements of temperature profiles in sodium have therefore been performed: an electrically heated test section, consisting of a smooth tube of 30.6 mm did; $Pr \approx 0.007$; $Re \approx 3700$ to 141,000. Temperature profiles, eddy diffusivity for heat ϵ_H and Nusselt numbers are presented in graphs and tables and compared with theoretical calculations. The eddy diffusivity ratio obtained follows quite closely Aoki's relation. Turbulent temperature fluctuations are of interest both for advanced theories and practical applications. However, most of the existing data refer to mercury. Within the above mentioned parameters, temperature fluctuations in sodium were measured with thermocouples of 0.5 mm and are reported as rms-values, probability density, auto- and cross-correlations and spectral densities. Some applications are promising, i.e., flow measurement by transit time analysis, and monitoring of LMFBR-subassemblies. An attempt to use a Russian "diffusion" method to compute ϵ_H out of fluctuation data was only partially successful. (auth)

15490 (FEI-380) HEAT-EXCHANGE DURING TURBULENT FLOW OF VARIOUS COOLANTS IN THE RING GAPS. Bobkov, V. P.; Ibragimov, M. Kh.; Savanin, N. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 30p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The results of the numerical calculation of the heat exchange during turbulent flow in concentric ring gaps of coolants with Prandtl numbers from 0 to 100 in the range of controlling parameters $r_1/r_2 = 0.0625$ to 1 and with Re numbers from 10^4 to 10^5 are reported. Approximation formulas were obtained which were common for the range of Prandt l numbers from 0 to 100. With the formulas it is possible to calculate the temperature regime of the walls during random ratio of the thermal flux. (tr-auth)

15491 (FEI-391) CALCULATIONS OF THE VELOCITY AND PRESSURE FIELDS IN A FLAT DISTRIBUTING COLLECTOR. Nomofilov, E. V.; Romanova, T. M.; Filimonov, V, T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 35p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

On the basis of the numerical solution of the Navier-Stokes equation a method is proposed for the calculation of the velocity and pressure fields in a flat distributing collector with consideration of the hydraulic strength of the grid in a wide range of Re numbers. Examples are given of the calculation. It is shown that the hydraulic strength of the grid has great effect on the velocity and pressure distributions. (tr-auth)

15492 NEW CLASSIFICATION OF TWO-PHASE FLOWS. Pai, S. I. J. Math. Phys. Sci.; 6: No. 2, 137-161(Jun 1972).

A descriptive discussion of the various types of two-phase flows in which the mechanics of the two phases of matter are treated simultaneously is presented. Two-phase flows are divided into two distinct groupings. They are: (1) flows which are a mixture of two phases of matter, solid and liquid, gas, and/or plasma, and (2) flows in which the interactions between their interface is important. Detailed discussions of the various types of two-phase flows are given with detailed descriptions of the various phases of the flow. A systematic description of two-phase flows is presented which may be of interest for those involved in this aspect of fluid mechanics. (Appl. Mech. Rev.)

15493 HEAT TRANSFER AND PRESSURE DROP COMPARISON IN TUBES WITH TRANSVERSE RIBS AND WITH TWISTED TAPE. Bolla, G.; De Giorgio, G.; Pedrocchi, E. (Instituto di Fisica Tecnica, Milan). Energ. Nucl. (Milan); 20: No. 11, 604-613(Nov 1973).

A comparison on an experimental basis between two of the most promising heat transfer enhancement devices in tubes, carried out using gas as a coolant, is presented. The devices, transverse ribs and twisted tapes respectively, can be both classified as turbulence promoters. The Reynolds numbers investigated range from 10^4 to 3×10^5, an interval which covers the area of major interest for industrial applications. It is shown that transverse ribs allow better overall performances to be achieved; both of the devices, however, appear more effective than the flow rate increase. Moreover, it is emphasized that the two types of turbulence promoters show a different behavior when the flow rate is varied with respect to the nominal operating conditions. (auth)

15494 INVESTIGATION OF THE TEMPERATURE FLUCTUATION IN TWO-PHASE SUPERHEATED LAYERS DURING BOILING OF THE LIQUID. Afgan, N. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 62-69(1973). (In Russian).

One of the basic parameters determining the intensity of the heat exchange at the boundary layer of the liquid and vapor phase is the superheating of the liquid during boiling. In two-phase boundary layers, superheating represents a variable (fluctuating) magnitude dependent on various parameters of the system and having a sta-

tistical character. The investigation of the statistical character of the fluctuation of the superheating of the liquid was the purpose of this study. On the basis of experimental data on the measurement of the temperature fluctuation in the two-phase boundary layer during boiling of the water, contiguous with the horizontal heating surface, a statistical analysis was carried out of the fluctuation amplitudes. On the basis of this analysis the mean and maximum superheating was determined in dependence on the distance to the heated walls. For determination of the microstructure of the temperature fluctuation and investigation of its origin, high-speed filming of the thermocouple head in contact with the two-phase medium was carried out. It was established that the presence of different-sized amplitudes is basically connected with two effects—the existence of superheated layers on bubbles during their growth and convection of the liquid near the bubbles. (tr-auth)

15495 NATURE OF MOTION OF A LIQUID ABOUT A VAPOR BUBBLE. Kutateladze, S. S.; Mamontova, N. N. (Inst. of Thermophysics, Novosibirsk, USSR). Heat Transfer–Sov. Res.; 5: No. 6, 149-153(1973).

An experimental study is described of the behavior of a fluid about a nucleating and growing vapor bubble. The flow pattern was obtained by high-speed moving picture photography of visualizing particles. It is found that the highest flow velocities are those during the initial stage of bubble inception and these are higher the closer the particles to the nucleation sites. The particulate velocities decrease with a reduction in the rate of bubble growth. (auth)

15496 TEMPERATURE REGIME OF A STEAM-GENERATING SURFACE ON DEPARTURE FROM NUCLEATE BOILING (DNB). Vorob'ev, V. A.; Kirillov, P. L.; Remizov, O. V.; Subbotin, V. I. (Inst. of Physical Energetics, Obninsk, USSR). Heat Transfer–Sov. Res.; 5: No. 6, 141-148(1973).

An experimental study is described of the temperature fields of steam-generating tubes under conditions of departure from nucleate boiling (DNB). One of the questions considered is the validity of applying data obtained with short test tubes to real tubes which are usually longer. The opinion is expressed that the reduction in heat transfer rate found to accompany the rise in heat flux on DNB is attributable to the inequilibrium state of the flow and to shifting of the point of conversion of the liquid film into steam. (auth)

15497 NATURAL CONVECTION NUCLEATE BOILING CRISIS OF HELIUM IN VERTICAL CHANNELS. Vishinev, I. P.; Vinokur, Ya. G.; Shaposhnikov, V. A.; Gorokhov, V. V. Heat Transfer–Sov. Res.; 5: No. 6, 120-127(1973).

Experimental results are presented of the study of the nucleate boiling crisis of Helium I in vertical circular channels under conditions of natural convection and in a pool at the surface of the vertical cylinder. Experiments were carried out at atmospheric pressure. The effect of channel geometry on the crisis of nucleate boiling of helium and the role of pre-inclusion and post-inclusion of unheated sections were studied. The relations are improved, acceptably approximating the experimental results. (auth)

15498 HEAT TRANSFER AND PRESSURE DROP IN TRANSVERSE FLOW ACROSS BUNDLES OF FINNED TUBES. Stasyulyavichyus, Yu. K.; Skrinska, A. Yu.; Survilla, V. Yu.; Samoshka, P. S. (Inst. of Physical and Technical Problems of Energies, Vilnyus, USSR). Heat Transfer–Sov. Res.; 5: No. 6, 19-33(1973).

Experimental results of heat transfer and pressure drop of staggered banks of finned tubes are presented for air flows at high from 10 to 10^5) Re. Experiments include 12 banks of different fin parameters. The results of heat transfer of the banks according to relative heat transfer coefficient are presented in the form of critical equations. Efficiency, volume, weight and other features of the banks are compared. The effect of fin parameters is analyzed, and general relations of heat transfer are derived which determined the influence of the parameters s/d and h/d on the heat transfer of the bank. (auth)

15499 TURBULENT STRUCTURE OF ISOTHERMAL AND NONISOTHERMAL LIQUID METAL PIPE FLOW. Hochreiter, L. E.; Sesonske, A. (Purdue Univ., Lafayette, IN). Int. J. Heat Mass Transfer; 17: No. 1, 113-123(Jan 1974).

The structure of fully developed mercury pipe flow, with and without heat transfer, was studied at a Reynolds number of 50,000 using a hot-film anemometer. Traverses were made in a 1.434 in. dia. vertical heated test section at a constant wall heat flux of 3820 Btu/h/ft^2. Axial turbulent velocity fluctuation measurements in isothermal pipe flow were made with both x-sensor and single-sensor hot-film probes. The radial turbulent velocity fluctuation intensity and the turbulent shear stress were also measured with an x-sensor probe. General agreement of the velocity results with corresponding measurements made in air indicates that the mercury flow turbulent velocity structure is similar to other fluids. The production and dissipation of turbulent kinetic energy were calculated from both single sensor and x-sensor data and were found to agree closely with the air data of Laufer. [NACA Report 1174 (1954)]. Turbulent temperature fluctuations, measured by using the hot-film anemometer as a resistance thermometer, were found to agree with the results of other measuring techniques. The turbulent axial heat flux, $\rho c_p \overline{u'\theta'}$, and the turbulent radial heat flux, $\rho c_p \overline{v'\theta'}$, were also measured with both single and x-sensor hot-film probes using a modified Kovasznay method to separate temperature and velocity sensitivities. The combination of relatively poor velocity sensitivity combined with the large temperature sensitivity and superimposed axial free convection resulted in uncertain values of $\overline{u'\theta'}$. The measured values of $\overline{v'\theta'}$ were unusually large in the wall region but indicated that convective and conductive transport were nearly equal in the turbulent core region. (auth)

15500 HIGH SPEED TWO-PHASE FLOW. I. Theory on Axial Change of Flow Parameters and Critical Flows. Adachi, H. (Japan Atomic Energy Research Inst., Tokai, Japan). Nippon Genshiryoku Gakkaishi; 15: No. 10, 693-701(Oct 1973). (In Japanese).

A new theoretical method for analyzing two-phase flashing flow is proposed. Two independent energy equations are used, one related to the unit flowing weight of the two-phase mixture and the other to its unit existing weight. This method can be applied to any one-component, two-phase flow, from subcritical to supercritical, provided the following basic assumptions are satisfied: one-dimensional flow; steady flow; adiabatic flow; gravity force is negligible; and thermally saturated flow. Two-phase critical flow can be determined as a maximum weight velocity flow, corresponding to the conditions dictated by the high pressure reservoir tank. Numerical calculations of critical parameters show good agreement with the experimental values. (auth)

15501 BOILING WITH LIQUID POTASSIUM IN SHORT ROD BUNDLES. Hoffman, H. W.; Huntley, W. R. (Oak Ridge National Lab., TN). Progr. Heat Mass Transfer; 7: 393-405(1973).

Results are presented from experiments to determine the critical heat flux with boiling potassium in upward forced flow in short, finite-array, rod bundles. The 30.5-cm-heated length test boiler was formed of seven 1.27-cm-OD heater elements arranged in triangular pattern at 20-mm separation within a heated shell contoured to simulate the next outer rod ring. Data obtained with two geometrically similar boilers at exit temperatures of 1033 to 1106°K showed critical fluxes of 132,500 to 268,000 W/m^2 with exit qualities of 58 to 93%. The effects of inlet subcooling, system pressure, shell heating, and central-rod excess heating on critical heat flux were also investigated. (auth)

Materials Testing

Refer also to abstracts 15515, 16271, 16423, 17552, 17558, 17568, 17569, and 17716.

15502 (IAEA-145) NONDESTRUCTIVE TESTING FOR REACTOR CORE COMPONENTS AND PRESSURE VESSELS. Report of a Panel, Vienna, November 29–December 1971. (International Atomic Energy Agency, Vienna (Austria)). 1972. 551p. (In several languages). (CONF-711114-).

Thirty papers and 3 annexes are included in the proceedings. A separate abstract was prepared for each. (LCL)

For abstracts of individual papers see: 15503–15529, 17552, 17558, 17568, 17569, 17576, and 17716.

15503 (IAEA-145, pp 49-68) NDT TECHNIQUES AT THE CNEN HOT LABORATORIES. Bozzoni, T.; Cochi, C. (CNEN, Rome). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The NDT techniques presently available at the CNEN Hot Laboratories in Casaccia (Rome) are discussed, with short descriptions of the various experimental apparatus and of applications in the past ten years to special testing problems. Development work is being done on other NDT techniques such as neutron radiography and eddy currents. Possible applications of these techniques to fuel performance evaluation in research programs of national interest are outlined. (auth)

15504 (IAEA-145, pp 79-86) NONDESTRUCTIVE TESTING IN THE U. S. A. DURING FABRICATION AND SURVEILLANCE OF PRESSURE TUBES. McClung, R. W. (Oak Ridge National Lab., TN). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Nondestructive testing techniques were applied to Zircaloy-2 pressure tubes for the PRTR both during fabrication and at intervals after operation. Techniques for inspection of the as-

fabricated tubes included ultrasonics for both wall thickness and flaw detection, radiography, fluorescent penetrants (on both inner and outer surfaces), and visual examination. Examination at intervals after reactor service included: visual examination using closed-circuit television and a borescope; measurement of flaw depth with a device incorporating a dial indicator; measurement of inner diameter with a probe containing linear variable differential transformers; and measurement with an eddy-current gage of the eccentricity of the annular space between the pressure tube and the surrounding shroud tube. (auth)

15505 (IAEA-145, pp 87-92) NEUTRON RADIOGRAPHY, AN ATTRACTIVE METHOD FOR THE NONDESTRUCTIVE TESTING OF IRRADIATED FUEL SPECIMENS. Stamm, W. J.; van der Kleij, N. 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Unlike x-radiography, neutron radiography can be a useful method for the nondestructive testing of irradiated fuel specimens. A summary is given of the principles and possibilities, and also a short description of the neutron radiographic facilities present at RCN in Petten. (auth)

15506 (IAEA-145, pp 93-105) POST IRRADIATION INSPECTION OF FUEL ELEMENTS: EXISTING METHODS AND EQUIPMENT USED IN THE STUDSVIK HOT CELLS. Jansson, L. (Aktiebolaget Atomenergi, Studsvik, Sweden). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The hot laboratory at Studsvik was planned for the study of the physical and metallurgical properties of materials irradiated in the materials testing reactor R2, for the examination of large fuel elements irradiated in reactors other than R2, and to provide a general service facility for handling highly radioactive material, e.g., changing and repairing isotope irradiation sources. The laboratory floor plan, the cell block design and shielding, and the manipulators are described. The use of various cells for visual inspection and disassembly, surface deposit removal, chemical analysis, dimensional measurements of fuel elements, gamma scanning, gas measurements and analysis, leak testing, burnup measurements, metallographic sample preparation and inspection, cladding analysis, and mechanical testing are discussed. (LCL)

15507 (IAEA-145, pp 107-121) BASE LINE AND IN-SERVICE INSPECTION OF THE STEEL PRESSURE VESSELS IN SWEDEN. 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The comprehensive nuclear reactor program in Sweden has called for an extensive study of possibilities and means for periodic inspection with the aid of NDT methods. The base line inspection of the Oskarshamn BWR unit 1 pressure vessel was carried out during the period 1969 and 1970. The experience gained in connection with this inspection work formed a basis for determination of inspection systems for other BWR units now being erected in Sweden. Special design considerations have been taken for the in-service inspection of the bottom area of these vessels, using a special design ultrasonic manipulator. Various types of outside channels will provide accessibility to the vertical and circumferential welds in this area. For a PWR unit in the 800 MW range, now under construction the same ultrasonic inspection technique will be employed as for the BWR pressure vessels. In this case a universal positioning fixture based on a telescopic, central mast design, will be used. With this fixture all of the vessel and primary inlet and outlet nozzle welds will be reached for inspection from the inside of the vessel. (auth)

15508 (IAEA-145, pp 155-167) NONDESTRUCTIVE TESTING OF IRRADIATED FUEL ELEMENTS IN THE U.S.A. McClung, R. W. (Oak Ridge National Lab., TN). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Many nondestructive testing techniques are being used to examine fuel elements after irradiation. Penetrating radiation techniques include both neutron and x radiography. Ultrasonic techniques are used to inspect bonding and to detect flaws in cladding; eddy-current techniques are used to measure spacing between components, measure thickness, and detect flaws. A variety of mechanical devices are used to measure physical dimensions. (auth)

15509 (IAEA-145, pp 169-182) ULTRASONIC IN-SERVICE INSPECTION OF REACTOR PRESSURE VESSELS. Meyer, H. J. (Maschinenfabrik Augsburg-Nuernberg AG, Nuremberg). 1972. (In English and German).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

In view of the safety requirements for nuclear reactor pressure vessels, nondestructive inspections are to be carried out not only during manufacture but also during the whole operational life of a reactor. Ultrasonic inspection systems and manipulation equipment are described which permit economical inspection of reactor components, at the same time avoiding subjective evaluation and manual probe guidance. The inspection system and manipulation are arranged so that when modern electronic components are employed two-dimensional flaws in particular, e.g., cracks, can be traced with a high degree of dependability. (auth)

15510 (IAEA-145, pp 183-192) NDT FACILITIES APPLIED TO Zr BASE ALLOY CAN FABRICATION. Ljungberg, L. (ASEA-ATOM, Vaesteraas, Sweden); Wiklund, J. 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The basis for specifications on NDT of fuel element canning is discussed together with the philosophy of rejection. This implies general demands on the manufacturing process. Properties considered in a specification for NDT are dimensions and mechanical defects. A review of general types of defects and the testing techniques in use is given, including ultrasonics, eddy current, and mechanical sensing. The calibration methods and the need for testing the transducers are considered to be important factors. (auth)

15511 (IAEA-145, pp 193-202) NONDESTRUCTIVE TESTING OF FUEL ELEMENTS AND THEIR COMPONENTS AS APPLIED BY THE BELGIAN MANUFACTURING INDUSTRIES: REVIEW OF METHODS. de Knock, R. (CEN, Mol, Belg.); Mostin, N.; Gerard, J. 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The situation in Belgium with respect to the nondestructive inspection used by the manufacturers of fuel pins and fuel assemblies is discussed. The pins are, typically, stacks of oxide pellets enclosed in metal tubes with welded closures at each end. The nondestructive tests and measurements applied to the basic material and the fuel pin before and after assembly are enumerated. (auth)

15512 (IAEA-145, pp 203-223) NONDESTRUCTIVE TESTING PROCEDURES DURING FABRICATION OF STEEL PRESSURE VESSELS. Trumpfheller, R. (Rheinisch-Westfaelischer Technischer Uberwachungs Verein eV, Essen, Ger.). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Though nondestructive testing everywhere is considered as very important for the safety of nuclear power plants, the NDT methods used in various countries and the acceptance rules differ in a relatively wide range. The differences between practices in the USA and Germany are discussed. For the ultrasonic inspection of plates and forgings nearly the same techniques are used in both countries but the sensitivity calibration and with it the acceptance rules are different. For the inspection of weld seams in Germany the ultrasonic examination is regarded as a much more reliable method than the radiographic inspection. Therefore, in many cases the radiographic examination is not applied if the ultrasonic inspection is carried out as a "complete ultrasonic inspection". According to ASME Code Section III the radiographic inspection dominates. (auth)

15513 (IAEA-145, pp 225-241) TESTING OF STAINLESS STEEL AND ZIRCONIUM ALLOY CANS FOR FUEL ELEMENTS. Prot, A. C. (CEN, Saclay, France). 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The nondestructive testing of canning tubes for nuclear reactor fuel elements is performed by using two main techniques, e.g., ultrasonics and eddy currents. The various aspects of ultrasonic nondestructive testing are discussed and include: choice of the testing method; working frequency; transducer(s) type; electronics; standards flaws; influence of the metallurgical structure; and incidence of specifications. Eddy currents are faced with difficulties related to their principle. The difficulties include: number of parameters involved; difficulty in extracting them from the raw signal; choice of the apparatus; matching of transducers (coils, probes, etc); influence of the working frequency; and limit of the various possible techniques. (auth)

15514 (IAEA-145, pp 243-269) SERIES OF NONDESTRUCTIVE TESTING OF THIN TUBES. Boulanger, G.; Dufayet, J. P.; Samoel, A.; Spriet, B.; Stossel, A. (DMECN/DDEC/SDECR, Cadarache, France). 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

In the course of the development of fuel elements for nuclear reactors, careful examinations of canning tubes were performed on pins for the various reactors. Numerous and various nondestructive tests were carried out on thousands of drawn or laminated seamless or welded tubes of either stainless steel or zirconium alloys. Based on the experience gained the methods

were compared and conclusions were made on their respective performances. This led to the definition of an entirely automatic control system. Three testing methods were used, i.e., multiple frequency eddy current testing, ultrasonics, and metrological testing. An eddy-current bench was used first for a soundness test in association with a metrological system which permits continuous measurement of mean diameter and ovality. An ultrasonic bench was used for additional defect detection and a simultaneous wall thickness measurement. Feeding of the machines and selection of the tubes were automatically achieved (sorting in various categories according to the tube quality). All of the information collected for each tube during these tests was recorded on punched cards using a data collecting system. (auth)

15515 (IAEA-145, pp 271-273) ULTRASONIC TESTING OF PRESSURE TUBES OF THE EL4 REACTOR. Prot, A. (CEN, Saclay, France). 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The various tests performed on the Zircaloy 2 pressure tubes for the EL.4 Reactor are reviewed. Contact as well as immersion (local, total) ultrasonic testing was considered. Wall thickness measurements were made using standard resonance ultrasonic testing. Problems related to inhomogeneities of the ultrasonic beams and to surface finish of the tubes were also taken into account. (auth)

15516 (IAEA-145, pp 275-292) SOME ASPECTS ON RADIOGRAPHIC AND ULTRASONIC INSPECTION OF BUTT WELDS IN STEEL REACTOR PRESSURE VESSELS. Dahn, S.; Oesterberg, J. (Aktiebolaget Atomenergi, Stockholm). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The advantages and disadvantages of radiographic and ultrasonic inspection of butt welds within the thickness range of from 150 to 200 mm are discussed. It is concluded that the use of both methods will result in the best inspection but under certain conditions only ultrasonic examination could be accepted. With radiographic inspection, the visibility of volumetric defects is very good if an adequate technique is used. The visibility of two-dimensional defects is shown in diagrams. Strongly compressed two-dimensional defects, e.g., a crack where one surface together with another forms a labyrinth that could be undetectable. With ultrasonic inspection some types of volumetric defects are bad reflectors. The detectability regarding two-dimensional defects is theoretically very good but an adequate technique must be applied and certain conditions must be considered. An ultrasonic inspection specification recently worked out in Sweden for the ultrasonic inspection of welds in reactor pressure vessels is briefly presented. Recommended reference blocks with flat bottom holes for sensitivity setting are shown in sketches. The specification presupposes that the character of the defects can be determined. The acceptance standard is partly based on fracture mechanics calculations. The permitted length of elongated volumetric defects, such as slag lines, is different for different types of welds and also depends on the depth from the surface to the defect. (auth)

15517 (IAEA-145, pp 293-347) NONDESTRUCTIVE TESTING OF COATED PARTICLE FUELS. Holliday, J.; Price, M. S. T. (Atomic Energy Establishment, Winfrith, Eng.). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The whole array of nondestructive tests used on unirradiated coated particle fuels for high temperature gas-cooled reactors, and specifically tests used for fuels for the Dragon Reactor, is generally described. Some methods are discussed in detail. Ways in which the complexity of the microminiature sized coated particle fuel has led to innovative nondestructive testing methods are discussed. Information is included on sampling and the statistical significance of test results, nondestructive methods for measuring particle dimensions, defects inspection, surface contamination, determination of ^{235}U content and distribution, data processing, and failed coated particle detection. (LCL)

15518 (IAEA-145, pp 349-356) METHODS OF NONDESTRUCTIVE TESTING DURING THE FABRICATION AND IN-SERVICE INSPECTION OF CONCRETE VESSELS, OF THEIR STEEL LINER, AND OF THE INTEGRATED EXCHANGERS. Roche, R. (CEN de Saclay, Gif-sur-Yvette, France). 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Since its first use at Marcoule in 1959, the application of prestressed concrete pressure vessels (PCPV) for nuclear reactors has gained increased attention and the nondestructive testing (NDT) of PCPV has been developed. From a general point of view, NDT problems in PCPV are very different from those associated with metal pressure vessels. Normal behavior of PCPV shows phenomena like cracking which are not expected in safe operation of metal vessels. Scale models are used in order to define normal PCPV behavior, and permanent instrumentation generally supplied with PCPV is used for NDT purposes. Conventional destructive tests, not real NDT inspection, are used for concrete and prestressing tendons. Metallic liners, cooling circuits, penetrations and closures are examined in the same way as metal vessels. Good water circulation and flow distribution in the cooling circuit are tested by means of a radioactive liquid flow inside the circuit. The whole PCPV testing takes place during proof testing. Leakage tests, crack pattern recording, overall deformation measuring, local strain monitoring, and tendon load monitoring tests were performed. In-service inspection is required by French regulations. The testing system used during proof testing performs this inspection. In addition, the NDT inspection of integrated steam generators is discussed. (auth)

15519 (IAEA-145, pp 383-409) NONDESTRUCTIVE TESTING FOR REACTOR COMPONENTS. Ando, Y. (Tokyo Univ.). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The nondestructive testing techniques applied to Zr alloy and stainless steel fuel can, pellets, and assemblies are described. The outline of post-irradiation inspection facilities to be constructed for fast breeder reactor fuels is introduced. Various NDT procedures used during the fabrication of pressure vessels are discussed and a comparison of radiographic and ultrasonic methods are given. The experience and the future possibility of in-service inspection are explored. The NDT problems of internals, especially ultrasonic testing of austenitic stainless steel weld metal, are presented. (auth)

15520 (IAEA-145, pp 411-416) NONDESTRUCTIVE TESTING IN THE FABRICATION OF STAINLESS STEEL CANS FOR NUCLEAR FUEL PINS. Mann, C. A. (United Kingdom Atomic Energy Authority, Springfields, Eng.). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Nondestructive tests are described which are applied to the material from which the cans are to be made, to intermediate stages of fabrication, and to the finished cans. The ultrasonic method is in general use in the early and final stages of fabrication, while the eddy-current method is also used in intermediate stages, as a complementary test to the ultrasonic one, or as a final test on tubing where for some reason the ultrasonic method is not convenient. The ultrasonic test which is now conventional for metal fuel element tubing is described. (auth)

15521 (IAEA-145, pp 419-425) POST-IRRADIATION INSPECTION OF FUEL ELEMENTS IN THE UK. Eldred, V. W. 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Nondestructive testing has been very important in the examination program on irradiated fuel elements in the UK. The techniques available include x-radiography, visual inspection, and photography (including peri-photography and photogrammetry), metrology, gamma scanning, leak testing, eddy current testing and neutron radiography. The essential characteristics and purposes of those techniques are briefly described. Topics that particularly require further development of nondestructive testing techniques are listed. (auth)

15522 (IAEA-145, pp 427-431) NONDESTRUCTIVE EXAMINATION OF NUCLEAR FUEL PELLETS IN THE U. S. A. McClung, R. W. (Oak Ridge National Lab., TN). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Several nondestructive evaluations are made of uranium- and plutonium-bearing fuels to assure conformance to specifications. These include visual examination with comparison to physical standards and measurement of dimensions, density, and fuel content. In addition to these that are commonly used, thermal techniques have been studied for density measurement, gamma attenuation has been used for measurement of fuel concentration, and both electron microprobe and autoradiographic techniques have been used to measure plutonium distribution in fuel pellets containing mixtures of plutonium and uranium oxides. (auth)

15523 (IAEA-145, pp 433-439) TECHNIQUES OF NONDESTRUCTIVE TESTING IN THE COURSE OF THE FABRICATION OF STEEL PRESSURE VESSELS. Roche, R. (CEN de Saclay, Gif-sur-Yvette, France). 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

NDT methods for reactor pressure vessels may be very different according to the use of the vessels. Experimental reactor vessels cannot be tested in the same way as those for nuclear power plants.

According to current practice, radiographic examination is performed on all welded joints. This inspection is no longer regarded as sufficient and ultrasonic examination is used in addition in order to detect cracks which are not detected by radiography. It is believed that ultrasonic inspection is the best method when reproducible recordings can be obtained. The advantages and disadvantages of ultrasonic and radiographic inspection are examined. In France, ultrasonic examination of austenitic welds was developed for the first French fast neutron nuclear plant (Phenix). Longitudinal waves, focalized transducers, and automatic testing apparatus were used. This method was very successful and specified defects were easily detected. Acoustic emission is a promising crack detection method, but research and development are still necessary, particularly in order to overcome the ambient noise perturbation. In France, research and development have been in progress for two years and a commercially available device has been developed. (auth)

15524 (IAEA-145, pp 440-442) USE OF ULTRASONICS AND RADIOGRAPHY AS A QUALITY CONTROL METHOD FOR REACTOR VESSELS. 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The efficiency of ultrasonic and radiography methods for the quality control of welds in reactor pressure vessels is shown. The advantages and inconveniencies of the two inspection methods are compared. It is concluded that they are complementary methods which together assure the absence of all defects. (JSR)

15525 (IAEA-145, pp 455-474) APPLICATION OF ACOUSTIC EMISSION AT THE SACLAY CENTER OF NUCLEAR STUDIES. Chretien, N. (DMECN/STA, Saclay, France); Tomachevsky, E. 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Studies at Saclay for evaluating acoustic emission testing as a nondestructive quality control technique are reviewed briefly. The acoustic characteristics of a number of materials were determined. Among these were austenitic steel, carbon steel, and the light alloy AG 5. The application of the method to the quality control of welds was studied. Laboratory and site tests were made to determine its use in the detection of structural faults. The use of the method for the location of emissive sources was also studied. The studies showed that this technique can be used for the analysis of the behavior of materials under stress, fabrication quality control, total quality control at the end of fabrication, inspection at the end of site installation, periodic inspection, and monitoring during operation. (JSR)

15526 (IAEA-145, pp 475-486) NONDESTRUCTIVE EXAMINATIONS OF IRRADIATED FUEL ELEMENTS. Watteau, M. (CEN, Saclay, France). 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Nondestructive methods for the examination of irradiated fuel elements for water reactors are described. These examinations generally take place in the storage swimming pool and the methods include leak testing, γ scanning, ultrasonic testing, eddy current testing, television examination, and neutron radiography. Each of these methods is briefly described. (JSR)

15527 (IAEA-145, pp 487-492) NONDESTRUCTIVE QUALITY CONTROL METHODS USED DURING THE FABRICATION OF FUEL ELEMENTS. Watteau, M. (CEN, Saclay, France). 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The nondestructive quality control methods used during the fabrication of fuel elements with fritted ceramic fuel and metallic jacketing are described. These fuel elements usually consist of a rod of fuel pins maintained in a regular geometric arrangement by structural pieces. The nondestructive testing used during the fabrication of the pin include inspection of the pin constituents, of welds and of the corrosion behavior of the jacket, leak testing, determination of the distribution of the internal constituents, and inspection of the jacket seals. The quality control methods used during the fabrication of the structural pieces and on the completed fuel element are briefly reported. (JSR)

15528 (IAEA-145, pp 507-524) ACOUSTIC EMISSION MEASUREMENTS AT REML. Kirby, N.; Bentley, P. G. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The development of high-sensitivity instrumentation for detecting and processing acoustic emission signals is outlined. Details are given of tests on fracture toughness test pieces of low-strength steels and the benefits and limitations of such data are discussed. A summary of development work to establish location techniques is given. (auth)

15529 (IAEA-145, pp 527-540) NONDESTRUCTIVE TESTING IN THE U. S. A. OF PRESTRESSED CONCRETE PRESSURE VESSELS FOR NUCLEAR REACTORS. McClung, R. W. (Oak Ridge National Lab., TN). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Many nondestructive testing techniques are used to assure the integrity of prestressed concrete reactor vessels in the U. S. Metallic members are examined by radiographic, ultrasonic, magnetic particle, and penetrant techniques to meet the requirements of ASME Boiler and Pressure Vessel Code, Section III. The concrete is fabricated to meet the requirements of the American Concrete Institute. After fabrication and during proof testing and operation, the test methods include measurement of stress on the prestressing tendons, strain on both concrete and metallic members, temperature, helium permeation, and moisture distribution in the concrete, leakage in the liner and penetrations, and ultrasonic examination of the liners for corrosion thinning. Acoustic emission is being investigated for possible application. (auth)

15530 CONTAINER INSPECTION SYSTEM AND METHOD. Calhoun, F. L. (to Industrial Dynamics Co., Ltd.). US Patent 3,784,827. 8 Jan 1974. Filed Date 5 Mar 1971. 8p.

An apparatus for inspecting a container to determine whether such container has properties different from a particular standard by utilizing a long life radioactive isotope source that emits low energy gamma radiation is described. The invention also relates to a method of making a very compact but safe housing to encapsulate the low energy gamma radiation source used in the apparatus. The housing utilized to encapsulate the radioactive source can provide adequate shielding to protect nearby personnel by using a metal such as stainless steel because of the low energy output of the source. A thin window, formed as an integral part of the housing, freely passes a portion of the source radiation that is used for inspection purposes. The housing is constructed from standard metal bar stock in a particular manner that minimizes the possibility that the thin window will include defects or impurities contained within the metal bar stock. A collimation means is utilized in front of the source housing window to confine the beam of radiation that emanates from the source through the window. This collimated radiation beam is directed at the area of the container to be examined and the amount of radiation passing through the container provides an indication as to whether or not the container has properties different from a particular standard. (Official Gazette)

15531 APPLICATION OF AN ELECTRONIC IMAGE ANALYZER TO DIMENSIONAL MEASUREMENTS FROM NEUTRON RADIOGRAPHS. Vary, A.; Bowles, K. J. (Lewis Research Center, Cleveland). Mater. Eval.; 32: No. 1, 7-17(Jan 1974).

Means of obtaining improved dimensional measurements from neutron radiographs of nuclear fuel elements are discussed. The use of video-electronic image analysis relative to edge definition in radiographic images is discussed. Based on this study, an edge definition criterion is proposed for overcoming image unsharpness effects in taking accurate diametral measurements from radiographs. An electronic density slicing method for automatic edge definition is described. Results of measurements made with video micrometry are compared with scanning microdensitometer and micrometric physical measurements. An image quality indicator for estimating photographic and geometric unsharpness is described. (auth)

15532 AUTOMATIC NONDESTRUCTIVE TESTING SYSTEM FOR THIN TUBES. Boulanger, G.; Dufayet, J. P.; Samoel, A.; Spriet, B.; Stossel, A. (CEN de Cadarache, St. Paul-Lez-Durance, France). Mater. Eval.; 32: No. 1, 18-24(Jan 1974).

Over the last few years, within the scope of the research into reactor fuel elements, extensive inspections of the cladding tubes for the fuel elements of the different reactor types were carried out. A number of various nondestructive tests have been made on thousands of smooth tubes, seamless or welded, drawn or rolled, in stainless steel or zirconium alloy. The experience enables one to compare the methods and to draw a number of conclusions with regard to their respective performance data. This has led to the definition of a fully automatic testing line. Three testing methods were used (multi-frequency eddy currents, ultrasonics, metrology), spread out over two operating plants: an eddy current bench for a preliminary soundness test combined with a metrology system permitting continuous measurement of the average diameter and of ovality; and an ultrasonic testing bench for additional detection of defects coupled with a simultaneous thickness measurement system. Supply and selection are automatic on these facilities (simultaneous sorting into several cat-

egories depending on tube quality). All data resulting from these tests are collected for each tube on punched cards by means of a data centralizing system. (auth)

Nuclear Explosions

Refer also to abstracts 15778–15780.

15533 (CONF-731101-47) MODIFICATION OF THE COLONY TOWER FOR THE RIO BLANCO DETONATION. Blume, J. A.; Lee, L. A.; Freeman, S. A.; Honda, K. K. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). [nd]. 21p. Dep. NTIS $3.25.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The tower is a 180-ft tall steel-frame experimental oil shale processing retort structure with heavy process equipment on various levels. The structural response of the tower to the ground motion from Project Rio Blanco is analyzed and the necessary structural modifications described. (TFD)

15534 (PEM-3) SHIELDING EFFECTIVENESS OF THE LIQUID TIGHT FLEXIBLE CONDUIT FROM TRANSIENT TESTS. Vance, E. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1971. 23p. Dep. NTIS $3.25.

Analysis and tests on a spiral-wrapped, mild steel, flexible conduit tube are reported. Experimentally, the transfer impedance was determined by attempting to produce a uniformly distributed current in the shield and measuring the corresponding electric field on the inside. A capacitor discharging into the coaxial line formed by the conduit and an external concentric cylinder provided the drive current, while the voltage developed along the entire length of the cable was measured. A diagram of the laboratory apparatus and representative waveform is provided. Analysis is provided to predict solenoidal rather than solid tube behavior. Shielding behavior was poor at higher frequencies, with the possibility of turn-to-turn arcing occurring under high current conditions. (auth)

15535 (UCID-15531) STRUCTURAL RESPONSES AND DAMAGE THRESHOLDS DUE TO GROUND EXCITATION. King, C. Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Oct 1969. 72p. Dep. NTIS $5.75.

Various investigations of thresholds of damage due to ground excitation are reviewed and summarized. Peak surface-particle motions, including acceleration, velocity, and displacement, are compared to experience with quarry blasting, underground nuclear detonations, and earthquakes. Emphasis is placed on ground motion characteristics, and different approaches to structural response are discussed. The influence of geologic environments on seismic responses and the problem of high-rise buildings are discussed separately because of their complex natures. A source of potentially valuable information stemming from a requirement in the Los Angeles Building Code is described. An "experience response multiplier," whose application provides a rapid field method of determining safe distances for structures and equipment, is discussed. This is a practical and useful tool for future underground nuclear experiments. (auth)

15536 (UCRL-51441) TECHNIQUE FOR GENERATING PRESSURE-VOLUME RELATIONSHIPS AND FAILURE ENVELOPES FOR ROCKS. Butkovich, T. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1973. Contract W-7405-eng-48. 36p. Dep. NTIS $4.00.

A technique has been devised for generating pressure-specific volume (P–V) and maximum shear stress-mean stress ($\tau-\bar{P}$) relationships for rocks. These relationships are necessary input for making underground nuclear explosion code calculations. With this new technique, it is possible to obtain good estimates of the P–V relationship for various types of rocks. It is also possible to obtain good estimates of the $\tau-\bar{P}$ relationship for rocks with weak intergranular bonds; such rocks are characterized by tuffs, alluviums, and saturated rocks in which pore pressure controls the strength of the rock. The results produced by this technique should prove useful in doing preliminary calculations and parameter studies without undertaking an extensive rock property measurement program. The necessary input parameters for generating these relationships are bulk density, grain density, weight fraction water, and elastic bulk modulus. (auth)

15537 FALL-OUT FROM BOMB TESTS. Mole, R. H. Brit. Med. J.; 4: No. 5891, 551(1 Dec 1973).

Estimates of fallout risks are discussed. It is pointed out that exposure from atmospheric bomb tests are not qualitatively different from exposure to natural background or medical radiation. It is also pointed out that arguments in favor of test bans may not be more persuasive for using a maximum estimates of risk. Particular reference is made to discussion in Australian Parliamentary Paper No. 29 1973, whose figures could not be checked due to lack of supporting bibliography. (UK)

Protective Structures and Equipment

Refer also to abstract 15779.

Safety Engineering

15538 (CONF-731122-1) DESIGN OF INDUSTRIAL FACILITIES TO MITIGATE EFFECTS OF DISASTERS. Pickel, T. W. Jr. (Oak Ridge National Lab., Tenn. (USA)). 1973. 9p. Dep. NTIS $3.00.

From conference on designing to survive disaster; Chicago, Illinois, USA (6 Nov 1973).

Design philosphy to be applied to industrial facilities to reduce the risk and effects of failures due to internal and external forces is discussed. (TFD)

15539 (REG/G-3.14(10-73)) SEISMIC DESIGN CLASSIFICATION FOR PLUTONIUM PROCESSING AND FUEL FABRICATION PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Oct 1973. 2p. DRS.

Plutonium processing and fuel fabrication plants must be designed, constructed, and operated to protect the health and safety of the public from the release and dispersal of radioactive materials that might result from the effects of natural phenomena, including earthquakes. This guide describes a method acceptable to the USAEC Regulatory staff for identifying and classifying those plant features that should be designed to withstand the seismic effects from earthquakes. (TFD)

15540 (UCRL-50007-73-2) HAZARDS CONTROL PROGRESS REPORT NO. 46, JANUARY–APRIL 1973. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1973. Contract W-7405-eng-48. 25p. Dep. NTIS $4.00.

Progress and technical notes on the following topics are given: comparison of neutron spectra predicted by Monte Carlo calculations and determined by multispheres with passive detectors; the role of oxygen in the thermoluminescence of LiF; asbestos thermoluminescence analysis study; recent advancements in chest thickness measurements; neutron spectrometry; cartridge and canister test systems for the testing and certification laboratory; x-ray polarization studies; criticality note on fissile hydrides; novel chemistry fume hood valuation; computer program to design exhaust ventilation systems; process control in decontamination of radioactive waste water; Fourier transforms; and computer program to make probability plots. (TFD)

15541 EXPERIMENTAL DETERMINATION OF THE IGNITION TEMPERATURES OF SODIUM AND POTASSIUM METALS. Polykhalov, V. A.; Prisnyakov, V. F. At. Energ. (USSR); 35: No. 1, 51-52(Jul 1973). (In Russian).

Experiments in determining the ignition temperatures of pure sodium metal, technical sodium metal and technical potassium metal were carried out under the following conditions: (1) slow heating in air at a rate of 1.5 to 2 and 2.5 to 4° min; (2) putting the alkali metal in an experimental oven heated to the ignition temperature in air; and (3) heating the alkali metal to the ignition temperature in argon with subsequent burning in air or in oxygen. With slow heating in air the ignition temperature varied from 437 to 462°K at a heating rate of 1.5 to 2°/s, and from 405 to 420°C at a heating rate of 2.5 to 4°/s. Slow heating of potassium metal at a rate of 2.5 to 4°/s leads to vigorous oxidation at 260 to 270°C, but ignition does not take place. On putting the alkali metal in a preheated oven, ignition of technical and pure sodium metals takes place at 390 to 400°C, and of potassium metal at 450 to 460°C. The ignition time is 40 to 60 seconds after putting the metal in the oven. On first heating the metal in argon the ignition temperatures varied from 334 to 339°C for sodium metal with air flow, from 416 to 426°C for potassium metal with air flow, and from 285 to 293°C for sodium metal with an oxygen atmosphere. Secondary ignition of sodium metal in air, whose burning was stopped by the passage of argon, takes place at 90 to 150°C. Thus the temperature of the secondary ignition of sodium is significantly below that of the primary ignition. (SJR)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 15279, 15735, and 17743.

15542 (INIS-mf-165-5) CHARACTERISTICS OF URANIUM ORE COMPOSITION AND ANTHRAXOLITE OCCURRENCE IN THE PRIBRAM DEPOSIT VEINS. Kominek, J.; Prokes, S. (Uranove Doly, Pribram (Czechoslovakia). Odstepny Zavod). [nd]. 18p. (In Czech). INIS.

Uranium minerals found in the Pribram deposit in Central Bohemia are described. Attention is paid to uranium anthraxolite in the ore vein filling. Uranium anthraxolite is a mixture of highly polymerized bitumen with pitchblende and coffinite. The location of minerals in the deposit and their origin are discussed. (INIS)

15543 (INIS-mf-165-6) DEVELOPMENT OF MAIN STRUCTURAL ELEMENTS IN THE DEPTH OF THE PRIBRAM URANIUM DEPOSIT. Petros, R. (Uranove Doly, Pribram (Czechoslovakia). Odstepny Zavod). [nd]. 14p. (In Czech). INIS.

Characteristics of the Pribram uranium deposit—geological location, fold structure, and fault structure—are outlined. A detailed description is given of folds and their filling. Special attention is paid to the faults filled mainly by carbonate filling. (INIS)

15544 (INIS-mf-165-7) STRUCTURAL AND TECTONIC CONDITIONS IN THE SLAVKOVICE DEPOSIT. Bajer, B. (Uranove Doly, Dolni Rozinka (Czechoslovakia). Odstepny Zavod). [nd]. 31p. (In Czech). INIS.

Characteristics are given of the Slavkovice uranium deposit—a small deposit with a high-content, contrast mineralization. The geological location of the ore area, the petrographical and tectonic description, the morphology and mineral composition of zones and veins, and laws of the location of uranium mineralization are discussed. The research and exploitation work and its influence on future development of surveying and mining in the Elbe region are evaluated. (INIS)

15545 (INIS-mf-165-10) SOME PROBLEMS OF DEEP LEVEL MINING IN THE PRIBRAM URANIUM DEPOSIT. Martinek, J.; Stenczel, J. (Uranove Doly, Pribam (Czechoslovakia). Odstepny Zavod). [nd]. 29p. (In Czech). INIS.

Problems are discussed relating to deep level mining, e.g., rock bursts, extraction methods under these conditions, climatic conditions and their influence on miners' work. In spite of extensive research efforts, rock bursts have not yet been prevented but have been reduced considerably. The rock temperature was found to be 28°C at a depth of about 1000 m, and as much as 42.9°C at a depth of about 1750 m. The problem of high temperature is to be solved either by reducing the relative humidity or by cooling the mine air. As to extraction methods, it is advisable, below 1200 m, to reduce the stope height to 45 to 55 m and the stope length to 40 to 60 m. (INIS)

15546 (INIS-mf-165-12) LEACHING OF LOW-GRADE ORES IN THE VITKOV II MINE. Sokola, K. (Uranove Doly, Zadni Chodov (Czechoslovakia). Odstepny Zavod Zapadni Cechy). [nd]. 9p. (In Czech). INIS.

The experience is described gained in the Vitkov II mine from soda heap leaching of low-grade uranium ores. The history and development of chemical leaching plants are dealt with. The production development in the period from 1965 to 1969, and the foreseen development of the method to 1975 are outlined. (INIS)

15547 (INIS-mf-766-1, pp 205-224) MATHEMATICAL METHODS OF PLANNING THE DEVELOPMENT AND EXPLOITATION OF URANIUM ORE DEPOSITS BY HYDRAULICKING. Novak, J. (Uranove Doly, Hamr na Jezere, Cech.). [nd]. (In Czech).

In planning the development of new fields and their exploitation by hydraulicking the optimum density and the shape of drilling should be established as well as the basic regime of the exploitation, i.e. the flow and the doses of chemical reagents. The principle is discussed of formulating the criterion function for optimization calculation. A possible application of computers is dealt with and a practical computation of optimum parameters is described for the Cretaceous system in Northern Bohemia. (INIS)

15548 (INIS-mf-766-2, pp 307-338) USE OF SPECIAL FILLS IN EXPLOITATION OF SEDIMENTARY URANIUM ORES IN COMPLEX HYDROGEOLOGIC CONDITIONS. Simek, P. (Vyvojovy Zavod Uranoveho Prumyslu, Kamenna, Czech.). [nd]. (In Czech).

Particular conditions in Czechoslovakia of sedimentary uranium ore deposit exploitation are discussed, and the mining methods applied as well as the technology of filling the worked-out space using solidifying fills are reviewed. The research into solidifying fill materials produced from power station ash is dealt with in more detail. Future trends of the research are indicated and a possible rationalisation of mining methods used in complex hydrogeologic conditions is contemplated. (INIS)

15549 (INIS-mf-766-6, pp 1-18) DIRECT DETERMINATION OF U AND Th BY LOGGING. Matolin, M.; Dedacek, K. (Karlova Univ., Prague). [nd]. (In Czech).

An outline is given of the prospects of gamma spectrometry, natural selective gamma-logging, and x-ray fluorescence analysis in the determination of uranium deposit reserves. The application of the above methods should be preceded by a number of experiments. A small application depth is the common feature of the methods. The problem of direct determination of radioactive elements in rock formations can positively be solved by the development of logging by neutrons. (INIS)

15550 (INIS-mf-766-7, pp 19-39) EXPERIENCE WITH THE APPLICATION OF FIELD GAMMA SPECTROMETRY. Altynoev, J.; Anft, A.; Kornilov, F.; Stara, S. (Ceskoslovensky Uranovy Prumysl, Pribram). [nd]. (In Czech).

Determination of the content of U (Ra), Th, and K by gamma spectrometry represents another stage in the development of radiometric methods of mineral prospecting and of geological mapping. A survey is presented of geological and chemical prerequisites for the application of gamma spectrometry, of its physical and methodical characteristics, and of the first positive experience with its application. (VV)

15551 (INIS-mf-766-8, pp 41-62) ANALYSIS OF EFFECTIVENESS AND PROCEDURES OF EMANATION AND GAMMA RADIATION PROSPECTING USING TWO-METER DEEP TEST BORINGS. Duda, V.; Vesely, V. (Geologicky Pruzkum Uranoveho Prumyslu, Liberec, Czech.). [nd]. (In Czech).

The results are presented of emanation and gamma surveying in two meters deep test borings carried out in 1961 in Moravia (Czechoslovakia) in an area of 213.5 sq. km. The area had previously been surveyed using the emanation method with test borings one meter deep. Using the former method, 636 new anomalies were discovered, which is 3 new radioactive objects per one square kilometer. This clearly proved the high area efficiency of the emanation and gamma method in test borings up to two meters deep. The analysis of the efficiency of the method was carried out using the material obtained in past years during the data processing of the Bohemian massif. In the analysis the results were compared obtained by the two methods and a comparison was also made of the data typical of the fields of the concentration of emanations and of the intensity of natural gamma radiation in two meters deep borings above the same sources of anomaly. The analysis shows that the measurement of both fields yields a detailed characteristic of radioactive objects that facilitates the geophysical interpretation and the orientation of technical efforts, while the application of one parameter only would, for various reasons, reduce the area efficiency of the method. (INIS)

15552 (INIS-mf-766-9, pp 121-140) COMPACT SYSTEM OF AUTOMATIC PROCESSING OF LOGGING MEASUREMENTS IN URANIUM DEPOSITS OF THE NORTH BOHEMIAN CRETACEOUS SYSTEM. Krestan, J. (Geologicky Pruzkum Uranoveho Prumyslu, Hamr na Jezere, Czech.). [nd]. (In Czech).

Digital recorder DKR 22 is described and its properties are listed. The recorder makes possible efficient and sufficiently accurate digital recordings of all logging data for shallow borings, without graphical representation. The system of algorithms is outlined for processing by MINSK 22 computer of the logging data obtained by DKR 11 and DKR 22. The digital recording made it possible to cut down the duration of measurements and improved the accuracy. (INIS)

15553 STUDY OF RADIOACTIVITY OF DINOSAUR BONES WITH A HIGH-RESOLUTION GAMMA SPECTROMETER. Gun-Aazhav, T.; Ger'ish, Sh.; Otgonsuren, O.; Sereeter, Zh.; Chultem, L. At. Energ. (USSR); 35: No. 2, 130-132(Aug 1973). (In Russian).

Gamma spectra of prehistoric animal bones showed the presence of naturally radioactive elements: ^{40}K, ^{234}Th, ^{228}Ac, etc. The data showed a high coefficient of release of radon, which is due to the porous structure of the bones. Values differ for bones from different locations and taken at different times of the year and depend somewhat on the medium in which they are embedded, e.g., radon release from porous sand is more rapid than from a denser soil. Therefore the gamma activity is not necessarily an

indication of the uranium content. The determination of the uranium content of bones from the gamma activity is possible only under conditions that ensure equilibrium (e.g., after storage of a sample in a sealed ampule for at least a month). (tr-auth)

15554 OCCURRENCE OF GADOLINITE NEAR KARATTUPPATTI, MADURAI DISTRICT TAMILNADU. Perumal, N.V.A.S. (Dept. of Atomic Energy, New Delhi). Curr. Sci. (India); 43: No. 1, 3-5(5 Jan 1974).

Chemical and spectrographic analyses of a greenish-black radioactive mineral from a zoned pegmatite near Karattuppatti showed 51.84% $Ce_2O_3 + La_2O_3 + Y_2O_3$, 9.0% BeO, 0.54% U_3O_8, 15.7% $Fe_2O_3 + FeO$, 22.04% SiO_2, and minor amounts of Er, Gd, Yb, Dy, Ho, Lu, Tm, B, Cr, Mg, Mn, and Zr. X-ray diffractometry confirmed it to be gadolinite, the second of its type to be reported from India. The presence of cerium as a major element in the mineral establishes it to be the variety cergadolinite. (auth)

15555 URANIUM IN SUBMARINE METALLIFEROUS DEPOSITS. Rydell, H. S.; Bonatti, E. (Univ. of Miami, FL). Geochim. Cosmochim. Acta; 37: No. 12, 2557-2565(Dec 1973).

Hydrothermal submarine metalliferous deposits, common in areas of the ocean floor with high heat flow, contain generally about 10 ppM U as an order of magnitude. The $^{234}U/^{238}U$ ratio is, in the majority of cases, close to that of seawater; only in a few cases is it anomalously high. Anomalous $^{234}U/^{238}U$ ratios are coupled with low U concentrations. These data are explained by a model where thermal water (essentially heated seawater) in its sub-bottom circulation often is unable to leach U from the basaltic oceanic crust; in fact, these thermal waters may in some cases lose U. When leaching of U from the basalt does take place, probably during shallow stages of the sub-bottom circulation, the resulting anomalous $^{234}U/^{238}U$ ratio can be preserved in the hydrothermal deposit only if mixing with "seawater" U is prevented. (auth)

15556 LESS KNOWN RADIOMETRIC ANOMALIES IN WESTERN BOHEMIA. Gnojek, I. (Ustav Uzite Geofyziky, Prague). Geol. Pruzkum; 15: No. 4, 105-107(Apr 1973). (In Czech).

The most marked radiometric anomalies of Western Bohemia are described as well as the applied methods of surveying. Measurements of the territory of air anomaly were performed with a portable Czechoslovak-made radiometer, type PSR-01. Gamma radiation was detected by an NaI(Tl) scintillator. The rock samples were taken from outcrops or from 70 to 100 cm-deep probes. The samples were subjected to laboratory spectrometric gamma analysis, whereby the origin of the individual anomalies was established. (INIS)

15557 SEARCH FOR NATURALLY OCCURRING SUPERHEAVY ELEMENTS. Stoughton, R. W.; Halperin, J.; Drury, J. S.; Perey, F. G.; Macklin, R. L.; Gentry, R. V.; Moore, C. B.; Noakes, J. E.; Milton, R. M.; McCarthy, J. H.; Sherwood, D. W. (Oak Ridge National Lab., TN). Nature (London) Phys. Sci.; 246: No. 150, 26-28(12 Nov 1973).

Several ores, minerals, concentrates and special samples were examined for evidence of superheavy elements using a neutron multiplicity counter. This counter contains 20 ^3He detectors in a paraffin matrix, and enables evaluation of the emitted neutron multiplicity spectrum of large samples with little or no chemical processing. Such measurements provide an effective tool in the search for superheavy elements, since their decay or the decay of daughter nuclides is expected to proceed by spontaneous fission. In a search for Element 114(ekalead) a massive galena sample and a sample of galena-barite were examined, together with some chalcophilic samples, iron and zinc sulphides, cerussite ($PbCO_3$), and flux dust samples in Cottrell precipitators from the roasting of pentlandite (iron nickel sulphide). Element 114 would be expected to be more volatile than Hg, and intermediate between Pb and Au in nobility, and for this reason a technique was applied which was successfully developed to locate Hg ore bodies. This technique is described. In another attempt to detect possible volatile superheavy elements, such as 118 (ekaradon) or 112 (ekamercury) a sample of silica gel was examined, previously used in a plant for the production of noble gases; a gas mixture of crude Xe from the same plant was also investigated. With regard to Element 110 (ekaplatinum) several ultrabasic rocks were examined. For Element 119 (ekafracium) several potash ores were examined, as well as bittern from the Great Salt Lake, Utah. A sample of native Bi, as well as reagent Bi, were examined for Element 115 (ekabismuth). Several special samples included iron-rich meteorites, samples of biotite in which dwarf haloes had been found, some monazite samples associated with giant haloes, and some haematite and magnetite samples; also manganese nodules, sharks' teeth, and carbonaceous chondrite meteorite samples. The latter were particularly interesting since there is a Xe component in some carbonaceous chondrites that shows a higher $^{136}Xe/^{134}Xe$ ratio than Xe from any known fission source, possibly due to fission of one or more relatively volatile superheavy elements. All the results are summarized in tabular form. None of the samples examined showed evidence of spontaneous fission rates in excess of the detection limit. (UK)

15558 URANIUM MINERALIZATION IN NORTHERN SCOTLAND, WALES, THE MIDLANDS, AND SOUTHWEST ENGLAND. Bowie, S. H. U.; Ostle, D.; Campbell, C. B. (Inst. of Geological Sciences, London). Inst. Mining Met., Trans./Sect. B; 82: 177-179(Nov 1973).

The early results of the reconnaissance for uranium conducted on behalf of the United Kingdom Atomic Energy Authority by the Institute of Geological Sciences from 1968 to 1973 have already been published, and the discoveries made in northern Scotland and in Orkney were summarized. The results of some further investigations in Orkney are given here, together with findings in four other regions, including parts of north Wales, the southern Pennines, the Midlands, the South Wales coal field and southwest England. The methods adopted for the reconnaissance consisted mainly of geochemical sampling of stream water and sediment and, in the English Midlands, of wells and boreholes. In addition, vehicle-mounted scintillation counter traverses of roads, on-foot radiometric reconnaissance of selected regions and detailed radiometric gridding of smaller areas of special interest were carried out. (auth)

15559 ANOMALIES OF THE NATURAL ISOTOPIC ABUNDANCE OF ^{239}Pu. Meier, H.; Boesche, D.; Albrecht, W.; Hecker, W.; Menge, P.; Unger, E.; Zeitler, G.; Zimmerhackl, E. (1973). vp. (In German).

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

The natural abundance of Pu-239 whose natural occurrence has been first confirmed by Seaborg and Perlman in 1948 was standardized by the $^{239}Pu/^{238}U$ ratio in uranium ores as being 3×10^{-12}%. New values, which were determined in radiogeochemical studies by Cherdyntsev and coworkers, revealed anomalously high Pu contents in igneous rock samples and hence call for an intensive search for such anomalies of the ^{239}Pu abundance. Some results obtained in chemical processing of sediments, minerals, and igneous rocks applying a Pu-238 tracer technique are reported. The possible reason of the ^{239}Pu anomalies found is discussed in the light of the natural occurrence of superheavy elements. (GE)

15560 MIGRATION OF STABLE NEON ISOTOPES IN MINERALS. Ashkinadze, G. Sh.; Sharif-Zade, V. B.; Shukolyukov, Yu. A. (Inst. of Geology and Geochronology of the Precambrian, Leningrad). Geokhimiya; No. 11, 1704-1710(Nov 1973). (In Russian).

The kinetics of the liberation of excess neon isotopes (^{21}Ne, ^{22}Ne) during thermal annealing of three uranium-containing minerals: samarskite, betafite, britholite has been investigated. The $^{21}Ne_{exc}$ and $^{22}Ne_{exc}$ fractionation effect during samarskite annealing has been established, which confirms the hypothesis about the formation of these isotopes as a result of (α,n)-reactions on ^{18}O and ^{19}F nuclei. Separation of the radiogenic ^{21}Ne and ^{22}Ne isotopes during their liberation from minerals may serve as explanation of the relative enrichment of excess neon in natural gases in the ^{22}Ne isotope. A comparison of the character of radiogenic xenon, neon and helium liberation during annealing of minerals allows estimation of the natural preservation state of excess neon by interpolation between corresponding coefficients for helium and xenon. (auth)

15561 RADIATION FACTOR IN THE POLYMETAL MINES OF THE GORUBSO MINING AND DRESSING ENTERPRISE AT LYKI AND ITS HYGIENIC SIGNIFICANCE. Akrabova, A.; Vyrbanov, P.; Raicheva, V. (Scientific-Research Inst. of Radiological and Radiation Hygiene, Sofia). Rudodobiv Met. (Sofia); 27: No. 7-8, 19-23(1972). (In Bulgarian).

The natural radioactivity in mines for working polymetallic ore veins is discussed. The following indices were investigated: gamma background; radon content in the mine air; uranium and radium content in the mine dust; radon, uranium, and radium in mine waters; and radioactive aerosols. The gamma background in the mine workings varies within the limits of from 3 to 40 R/s. The radium content in the mine waters varies with the limits of 2×10^{-12} to 8×10^{-12} g/dm. The concentration of radon in the ore dust varies from 3×10^{-12} to 6.7×10^{-11} Ci/dm. A local increase of the radium content in certain mines is due to insufficient ventilation. The radioactive aerosol concentrations are low and do not represent any specific radiation hazard. The radium content in ore dust is 2.8×10^{-11}% and uranium content 6.3×10^{-7} g/g. The silicon content in the dust varies in the limits of from 2.6 to 36.3%. Combinations of a high ore dust value, high silicon content, and certain concentration of radon daughter products have an effect on the miner's health. This should be taken into consideration in ex-

amining the professional pathology and hygienic working conditions in the polymetallic nonuranium ores. (INIS)

15562 URANIUM DEPOSITS IN THE MASSIF CENTRAL (FRANCE). Geffroy, J. (CEN, Fontenay-aux-Roses, France). pp 541-579 of Jean Jung Symposium on Geology, Geomorphology, and Deep Structure of the French Massif Central. Clermont-Ferrand, France; Pleur Air Service (1972). (In French).

From Jean Jung symposium on geology, geomorphology, and deep structure of the French Massif Central; Clermont-Ferrand, France (31 Mar 1971).

The potential of the uranium deposits of the Massif Central (France) is reviewed. Deposits in the different regions were studied and are divided into two principal categories: intergranitic seams, rock bodies, and veins (Limousin–Marche, Margeride, Forez and Morvan); sedimentary layers: Permian (Southern part of the Massif Central) and early Cenozoic (Auvergne). The age (Hercynian) and the characteristics of favorable granites are given for the first type of rock. Episyenites are discussed separately. Two systems of regional tectonic trends (NW–SE and NE–SW) occur in the epigenetic uranium distribution. Several different mineral associations are distinguished. The evolution of ideas concerning genetics over the past 18 years in France is discussed. Geochronological problems are then discussed. The epigenetic deposits of the Massif Central are compared with those of the principal Hercynian regions of Europe. (FR)

15563 STUDY OF THE DISSOLUTION OF COMPACT URANINITE SAMPLE BY SULFURIC ACID SOLUTIONS. Dymkova, G. A.; Kuz'mina, L. N.; Nesmeyanova, G. M.; Pribytkov, P. V. At. Energ. (USSR); 35: No. 1, 48(Jul 1973). (In Russian).

The rate of dissolution of uraninite samples in sulfuric acid solutions depends not only on the oxygen-to-uranium ratio, but also on the phase composition of the sample. Uraninite samples can be divided into three groups, which are distinguished by crystal lattice parameters, microhardness, and penetration depth of the surface layer. The most readily soluble is the uraninite formed on decomposition of coffinite. The lattice parameter of this compound is a = 5.36 – 5.39 A; the microhardness is 200 to 400 kg/cm^2, and the surface penetration thickness is 1.1 to 2.5 microns. Uraninite samples have a spotted distribution of insoluble sections, which are characterized by a lattice parameter a = 5.40 – 5.41 A, a microhardness of 500 to 700 kg/cm^2, and a penetration thickness of 0.1 to 0.5 microns. The least soluble in sulfuric acid solutions are uraninite samples with a lattice parameter a = 5.43 A, a microhardness of 950 to 1000 kg/mm^2, and a penetration of 0 to 0.1 microns. In its physical properties this uraninite is a natural analogue of synthetic cubic uranium oxide (U_4O_9). (SJR)

15564 REVIEW OF THE ENERGY SITUATION AND THE PRINCIPAL METALS AND MINERALS IN METROPOLITAN FRANCE AND OVERSEAS TERRITORIES IN 1972. Ann. Mines; 24-25(Aug 1973). (In French).

French uranium production between 1960 and 1972 is discussed. The world situation and the French situation (research, exploitation, and ore concentration) are reviewed. The costs and external trade aspects of the problem are considered. (FR)

15565 URANIUM EXPLORATION IN ITALY: RESULTS ACHIEVED AND PROSPECTS. Mittempergher, M. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 18: No. 4, 25-39(1972). (In Italian). (RT/GEO-(72)12).

Uranium exploration carried out in Italy is outlined. The geological criteria used are given and the exploration techniques are described. The principal uranium areas located are described. New areas to be explored are discussed. (JSR)

Radioactive Effluents

Refer also to abstracts 15364, 15488, 15573–15575, 15597, 15604–15609, 15657, 16061, 16418, 17676–17679, 17687, and 17688.

15566 (BNL-18350) ENVIRONMENTAL SAFETY EVALUATIONS FOR NUCLEAR INSTALLATIONS. Hull, A. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 23p. (CONF-731127-1). Dep. NTIS $3.25.

From meeting on radiological and environmental protection; Lima, Peru (19 Nov 1973).

Environmental safety has been an important consideration in the siting, design, and operation of nuclear installations. As a result there have been very few cases in which the releases of radioactive materials from these installations have posed a dosimetrically significant environmental risk, and almost all of these have been connected with accidents or other unintentional situations. In no situation do the intentional releases from nuclear installations appear to have posed significant environmental risks, and with adequate planning and design a high degree of environmental safety may be assured. Many disciplines are involved in the evaluation of safety for nuclear installations. These include such fundamental ones as physics, chemistry, and biology, and more specialized ones such as meteorology, engineering, ecology, medicine, and electronics. A comprehensive review of environmental surveillance data and estimates of dose commitments from nuclear installations suggests that compared to the doses from background and from fallout, those attributable to the effluents from nuclear facilities have been small and for the most part quite local. It is concluded that, the upper limit of the risk associated with exposure of up to a few millirems per year is indeed small compared to many other commonly accepted risks of living in present day society. (72 references) (CH)

15567 NUCLEAR ENERGY AND THE ENVIRONMENT: ROLE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY. Finkelstein, A. (International Atomic Energy Agency, Vienna). pp 47-55 of Nuclear Energy and the Environment. Rome; Comitato Nazionale Energia Nucleare (1973). (In French).

From proceedings of the 17th nuclear congress; Rome, Italy (23 May 1972). See CONF-720356-.

The IAEA can impose radiation standards only if the agency is directly assisting an installation; in all other cases it can only make recommendations. Three types of activities undertaken by the IAEA with respect to liquid effluents and solid wastes are cited: study of the evolution of radioactivity in the oceans, management of solid wastes, and attempt to establish an international registry of radioactive wastes deposited in the sea. A brief review is given of peripheral activities. The role of the agency in the management of water resources is cited. The genetic improvement of plant species by radioinduced mutations, sterilization of insects by radiation, and sterilization of medical supplies are three areas in which nuclear energy contributes to the improvement of the environment. (JSR)

15568 WEERIE PROGRAM FOR ASSESSING THE RADIOLOGICAL CONSEQUENCES OF AIRBORNE EFFLUENTS FROM NUCLEAR INSTALLATIONS. Clarke, R. H. (Central Electricity Generating Board, Berkeley, Eng.). Health Phys.; 25: No. 3, 267-280(Sep 1973).

A mathematical model was devised for guidance in the safety and siting aspects of nuclear installations under operational or accident conditions. The model begins with the full-fission product inventory applicable to the fuel at the time of interest generated for any reactor type and irradiation history. The amount of fuel involved in the incident may vary as a function of time and either a time decaying or constant fission product inventory may be used to specify the release. The activity leaks from the circuit with allowances for time-dependent plateout, resuspension and filtration of each elemental species. By preserving the full nuclide decay schemes, nuclides leaking into the atmosphere depend not only on their own release behavior but also on that of their precursors. The effluent in the atmosphere is dispersed from an effective stack height and allowance is made for building entrainment. Standard meteorological dispersion models are used and the effects of radioactive buildup and decay, ground and inversion reflections, and ground deposition are taken into account. WEERIE then evaluates the inhalation and the cloud β doses, while integration over the volume of the plume leads to estimates of the cloud γ exposure. WEERIE is written in FORTRAN IV (H) and executed on the IBM 370/165 computer requiring 250 kbytes of fast core storage. Execution times vary with the degree of precision requested in the cloud-γ routine, but typically doses and exposures may be evaluated at the rate of 200 observation points per minute. (auth)

15569 PROBLEMS ASSOCIATED WITH THE DISPOSAL OF RADIOACTIVE WASTES IN THE SEA. Ancellin, J. (CEN, Fontenay-aux-Roses, France). Agriculture (Paris); No. 366, 181-183(Jun 1973). (In French).

The disposal of radioactive wastes in the sea (case of the La Hague site) is favored by the physical dispersion and transport of the effluents by marine currents. Concentration and precipitation phenomena can inhibit the dispersion. Research has been effected on the way in which the fixing of pollutants occurs and the degree to which it occurs. Investigations were then carried out on the utilization of the marine environment by man (foodstuffs from the sea, distribution of such products, alimentation, critical population groups). (FR)

15570 RESULTS WITH RHODAMINE B AS A POLLUTANT TRACER IN SHALLOW SEAWATER. Bernhard, M.; Cagnetti, P.; Zattera, A. (CNEN–EURATOM, Casaccia, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 2, 71-80(1972). (In Italian).

Experiments designed to perfect a method employing Rhodamine B as a pollutant tracer in seawater carried out by the CNEN

Radioactive Sea Pollution Laboratory are reported. The study was confined to shallow coastal waters in March and April 1971, but was sufficiently indicative to enable a choice to be made between existing mathematical models proposed for pollutant diffusion. Further improvements are required at some points of the technique. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 15318, 15364, 15366, 15537, 15566, and 15658–15663.

15571 (BNWL-SA-4839) ENVIRONMENTAL MONITORING AT THE PACIFIC NORTHWEST LABORATORY BY BATTELLE-NORTHWEST. Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-1830. 21p. (CONF-731109-2). Dep. NTIS $3.25.

From 66th annual meeting of the American Institute of Chemical Engineers; Philadelphia, Pennsylvania, USA (11 Nov 1973).

The Hanford site is described and the rationale and standards of the environmental monitoring program at the Pacific Northwest Laboratory are discussed. It is pointed out that between December 1964 and January 1971 all reactors with once-through cooling were deactivated and the only production reactor remaining in operation has a closed primary cooling loop and releases only minor quantities of radioactivity to the Columbia River. As a result, the amount of radioactivity released to the environment, other than to soil within the plant reservation, has decreased to relative insignificance. The objectives of the radiation monitoring program are: to detect trends in the migration of radionuclides, to estimate the contribution of plant effluents to the radiation dose received by the local population, and to demonstrate compliance with applicable radiation protection regulations. (CH)

15572 (HW-72691-1) SUMMARY OF RADIOLOGICAL DATA FOR THE MONTH OF JANUARY 1962. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 14 Feb 1962. Contract AT(45-1)-1350. 9p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during January 1962. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{131}I in separations facilities stack effluents, surface air, and milk samples; the β activity in surface air; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15573 (HW-72691-3) SUMMARY OF RADIOLOGICAL DATA FOR THE MONTH OF MARCH 1962. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Apr 1972. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during March 1962. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np by the Columbia River; the estimated radiation dose to the gastrointestinal tract of man from radionuclides in drinking water; the β activity and content of ^{131}I from separations facilities stack emissions in surface air; the content of ^{131}I in milk samples; and estimations of the external radiation dose to personnel. (CH)

15574 (HW-72691-4) SUMMARY OF RADIOLOGICAL DATA FOR THE MONTH OF APRIL 1962. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 11 May 1962. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during April 1962. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np by the Columbia River; the estimated radiation dose to the gastrointestinal tract of man from radionuclides in drinking water; the β activity and content of ^{131}I from separations facilities stack emissions in surface air; the content of ^{131}I in milk samples; and estimates of the external radiation dose to personnel. (CH)

15575 (HW-72691-5) SUMMARY OF RADIOLOGICAL DATA FOR THE MONTH OF MAY 1962. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 11 Jun 1962. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during May 1962. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np by the Columbia River; the estimated radiation dose to the gastrointestinal tract of persons from radionuclides in drinking water, the total β activity and ^{131}I content of surface air, the content of ^{131}I in separations facilities stack emissions; and the content of ^{131}I in milk samples. (CH)

15576 (HW-76525-8) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR AUGUST 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 10 Sep 1963. Contract AT(45-1)-1350. 6p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during August 1963. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{131}I in separations facilities effluents, surface air, and milk samples; the β and γ activity in surface air; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15577 (HW-76525-9) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR SEPTEMBER 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 10 Oct 1963. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during September 1963. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{131}I in separations facilities effluents, surface air, and milk samples; the β and γ activity in surface air; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15578 (HW-76525-10) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR OCTOBER 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Nov 1963. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during October 1963. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{131}I in separations facilities stack effluents, surface air, and milk samples; the β and γ activity in surface air; and estimates of the radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15579 (HW-76525-11) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR NOVEMBER 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Dec 1963. Contract AT(45-1)-1350. 9p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during November 1963. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{131}I in separations facilities stack emissions, surface air, and milk samples, the β and γ activity in surface air; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15580 (HW-76525-12) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR DECEMBER 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 10 Jan 1964. 8p. Dep. NTIS $3.00.

Data are summarized on the radioactivity of environmental samples collected at Hanford during December 1963. Data are presented on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np by the Columbia River; the estimated radiation dose to the gastrointestinal tract of humans from ^{76}As and ^{239}Np in drinking water; the content of ^{131}I in separations facilities stack emissions in surface air, and in milk; and the β and γ activity in surface air. (CH)

15581 (HW-80892-2) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR FEBRUARY 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 19 Mar 1964. 8p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during February 1964. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{131}I in separations facilities stack emissions, surface air, and milk samples; the total β and γ activity in surface air; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15582 (HW-80892-3) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR MARCH 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 15 Apr 1964. 8p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during March 1964. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{131}I in separations facilities stack effluents, surface air, and milk samples; the β and γ activity in surface air; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15583 (HW-80892-4) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR APRIL 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 18 May 1964. 8p. Dep. NTIS $3.00.

Data are presented on the radioactivity in environmental samples collected at Hanford during April 1964. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the control of ^{131}I in separations facilities stack effluents, surface air, and milk samples; the β and γ activity in surface air; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15584 (HW-80892-7) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR JULY 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 11 Aug 1964. 24p. Dep. NTIS $3.25.

Data are presented on the radioactivity in environmental samples collected at Hanford during July 1964. Data are included on the rate of transport of ^{32}P, ^{65}Zn, ^{76}As, ^{51}Cr, and ^{239}Np in the Columbia River; the content of ^{32}P and ^{65}Zn in Willapa Bay oysters and milk samples; the content of ^{131}I in stack effluents, surface air, cattle thyroids, and milk samples; the β activity on air filters; the content of fallout ^{137}Cs and ^{90}Sr in milk samples; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15585 (HW-80892-8) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR AUGUST 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 14 Sep 1964. 21p. Dep. NTIS $3.25.

Data are presented on the radioactivity in environmental samples collected at Hanford during August 1964. Data are included on the estimated rate of transport of ^{32}P, ^{65}Zn, ^{51}Cr, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{32}P and ^{65}Zn in Willapa Bay oysters and milk samples; the content of ^{131}I in stack effluents, surface air, cattle thyroids, and milk samples; the β activity on air filters; the content of fallout ^{137}Cs and ^{90}Sr in milk samples; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15586 (HW-80892-9) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR SEPTEMBER 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 16 Oct 1964. 21p. Dep. NTIS $3.25.

Data are presented on the radioactivity of environmental samples collected at Handord during September 1964. Data are included on the content of ^{51}Cr, ^{65}Zr, and ^{32}P in Columbia River water; the transport of ^{32}P, ^{65}Zn, ^{76}As, and ^{239}Np in the Columbia River; the total β activity and content of ^{131}I in surface air samples and the emission rate of ^{131}I in stack effluents; the content of ^{131}I in thyroids of cattle and in milk; the content of ^{65}Zn in milk samples; the content of fallout ^{137}Cs and ^{90}Sr in milk samples; the content of ^{32}P and ^{65}Zn in Willapa Bay oysters; and estimates of the radiation dose to the gastrointestinal tract of persons from radionuclides in drinking water. (CH)

15587 (HW-80892-10) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR OCTOBER 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 18 Nov 1964. 24p. Dep. NTIS $3.25.

Data are presented on the radioactivity in environmental samples collected at Hanford during October 1964. Data are included on the content of ^{51}Cr, ^{65}Zn, and ^{32}P in samples of Columbia River water; the estimated rates of transport of ^{32}P, ^{65}Zn, ^{76}As, ^{51}Cr, and ^{239}Np in the Columbia River; the content of ^{32}P and ^{65}Zn in Willapa Bay oysters and milk samples; the content of ^{131}I in stack effluents, surface air, and milk samples; the content of fallout ^{137}Cs and ^{90}Sr in milk samples; the total β activity on air filters; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15588 (HW-80892-11) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR NOVEMBER 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 22 Dec 1964. 24p. Dep. NTIS $3.25.

Data are presented on the radioactivity in environmental samples collected at Hanford during November 1964. Data are included on the content of ^{51}Cr, ^{65}Zn, and ^{32}P in Columbia River water; the transport rates of ^{32}P, ^{65}Zn, ^{51}Cr, ^{76}As, and ^{239}Np in the Columbia River; the content of ^{32}P and ^{65}Zn in Willapa Bay oysters and milk samples; the content of ^{131}I in stack effluents, cattle thyroids, and milk samples; the β activity on air filters; the content of fallout ^{137}Cs and ^{90}Sr in milk samples; and the estimated radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15589 (HW-80892-12) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR DECEMBER 1964. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 18 Jan 1965. 25p. Dep. NTIS $3.25.

Data are presented on the radioactivity in environmental samples collected at Hanford during December 1964. Data are included on the content of ^{51}Cr, ^{65}Zn, and ^{32}P in samples of Columbia River water; the transport rates of ^{32}P and ^{65}Zn in the Columbia River; the total β activity and content of ^{131}I in stack effluents and surface air; the content of ^{131}I in cattle thyroids and milk, the content of ^{32}P and ^{65}Zn in Willapa Bay oysters; the content of fallout ^{137}Cs and ^{90}Sr in milk samples; and estimates of the radiation dose to the gastrointestinal tract of local residents from radionuclides in drinking water. (CH)

15590 (INIS-mf-887, pp 204-209) GENERAL MODEL FOR EVALUATING TRANSPORT OF RADIOACTIVE PRODUCTS RELEASED TO ENVIRONMENT AND ITS CONSEQUENCES. Hladky, E.; Kubik, I.; Moravek, J. (Vyskumny Ustav Energeticky, Jaslovske Bohunice, Czech.). [nd]. (In Czech).

A mathematical model is described elaborated for the evaluation of the transport and behavior of radioactive products released into the environment during the operation of nuclear power plants. It is based on the behavior of the products on the main protective barriers of nuclear power plants. A block diagram is presented of the model and the respective main programs are characterized. (INIS)

15591 (INIS-mf-887, pp 210-219) TEN YEARS OF RADIOACTIVE CONTAMINATION MONITORING BY THE HYDROMETEOROLOGICAL INSTITUTE. Santroch, J. (Hydrometeorologicky Ustav Praha, Czech.). [nd]. (In Czech).

The past ten years of activities in the field of radioactive contamination monitoring and measuring of the Hydrometeorological Institute are briefly reviewed. Measuring methods used by the Institute are described and main results are tabulated obtained for the period of 1967 to 1971 in measuring radioactive fallout and concentrations of some radionuclides. (INIS)

15592 (INIS-mf-914, pp 4-15) RADIOACTIVITY OF THE BIOSPHERE: INVESTIGATIONS IN SWITZERLAND. Huber, O. (Freibourg Univ., Switzerland); Halter, J.; Winiger, P. 1973. (In German).

From information meeting on the general radiation burden of modern man; Zurich-Oerlikon, Switzerland (23 Mar 1973).

The origins of the natural background of ionizing radiation caused by cosmic as well as terrestrial radiation are described. The resulting external radiation doses were measured in Switzerland giving values between 17 and 300 mR/a, which depend on the altitude and the geological formation. The internal radiation doses arising from incorporated natural radioisotopes, though very small, could be measured also. According to these results, in Switzerland, the total natural external and internal radiation doses to the gonads vary from 100 to 300 mrem/a with an economically weighted mean of 150 mrem/a. (INIS)

15593 (PNE-RB-51-6) RADIOLOGICAL MONITORING PROGRAM, MAY 17, 1973–JULY 31, 1973. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA)). 1973. 21p. Dep. NTIS $3.25.

For CER Geonuclear Corp., Las Vegas, NV.

Data are presented on the radioactivity in environmental samples collected in the vicinity of the Project Rio Blanco (Colorado) underground explosion on May 17, 1973. Results are reported for May 17 through July 31. Beta radioactivity in air particulate samples for this quarter remained at very low concentrations, ranging from 0.01 to 0.07 pCi/m^3. These values are no higher than those for the previous periods. Gamma scans of the air particulate samples (composite) indicated that the concentration of γ emitters were below the minimum sensitivity of the 4'' diameter × 4'' thick NaI(Tl) detector, and TLD data for this period indicated an average background radiation dose rate of 2.8 millirem per week. This is consistent with the dose rate measured in 1972. Beta radioactivity in surface water ranged from 0.0 to 8.3 pCi/l. Tritium concentrations were less than 1.0 pCi/ml, concentrations measured by electrolytic enrichment being in the range of 0.1 to 0.6 pCi/l. Gamma scans indicated no detectable activity above background and system sensitivity. Gamma isotopic (GeLi) analysis of milk indicated no significant concentration of γ emitters except natural ^{40}K. (CH)

15594 (SCPRI(RM)-7-1973) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants,

78 – Le Vesinet (France)). Jul 1973. 15p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The principal results obtained during the surveillance of radioactivity in the environment in France during July 1973 are reported. Topics covered include: atmospheric dusts (air at ground level, high-altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chains (milk, plants, cattle, fish), seawater around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also presented. (FR)

15595 (SCPRI(RM)-7-1973(Suppl.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details to the Results of Measurements. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Jul 1973. 25p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Measurements tables are presented concerning the radioactivity of the environment in France during July 1973. (FR)

15596 RADIOACTIVE WASTES IN INSTITUTIONS OF BIOLOGICAL RESEARCH. Kirchmann, R. (CEN, Mol, Belgium). J. Belge Radiol.; 56: No. 5, 443-450(1973). (In French).

The different radioelements used in the Belgian biological research laboratories and the activities used are indicated. The types of utilization of ^{3}H, ^{14}C, ^{32}P, ^{125}I, ^{131}I, ^{85}Sr, and ^{226}Ra and the handling procedures of contaminated wastes of these radionuclides are described. Finally, the release "in situ" was estimated for all the laboratories that were investigated. (auth)

15597 IZOTOPNYI SOSTAV RADIOAKTIVNYKH VYPADENII. (Isotope Composition of Radioactive Fallout). Izrael, Yu. A. Leningrad; Gidrometeoizdat (1973). 108p.

A review is presented of the isotopic composition of radioactive fallout in the presence of atmospheric and underground explosions and the main processes influencing the isotopic composition of fallout in the process of formation of aerosol radioactive carriers of particles. The formation and distribution of aerosol particles are described; the results of modeling these particles in a laboratory and some natural experimental data are given. The scheme of fractionating of radioactive products which helps to calculate an isotopic composition of fallout is presented. The role of meteorological processes in fallout formation and the influence of the processes on the isotopic composition and in the end on the contamination of natural environment are estimated. The book is recommended to the specialists in meteorology, studying the problems of atmosphere physics including radioactivity, as well as to the specialists dealing with the environmental protection problem. (auth)

15598 REPLY TO PLUTONIUM-239 CONTAMINATION IN THE DENVER AREA BY P. W. KREY. Poet, S. E.; Martell, E. A. (National Center for Atmospheric Research, Boulder, CO). Health Phys.; 26: No. 1, 120-122(Jan 1974).

Reference is made to the letter of Krey (Health Phys.; 26: 117 (1974)) in which he spoke of "omissions, errors, and misconceptions" in the present author's previous paper (Health Phys.; 23: 537(1972)). Such allegations of this author's work covering the spatial distribution of ^{239}Pu contamination, the sampling and analysis techniques used, and the ^{239}Pu distribution with depth, are argued. (UK)

15599 ^{239}Pu CONTAMINATION IN THE DENVER AREA. Krey, P. W. (Atomic Energy Commission, New York). Health Phys.; 26: No. 1, 117-120(Jan 1974).

It is stated that there are "omissions, errors, and misconceptions" contained in the report of Poet and Martell (Health Phys.; 23: 537(1972)) which indicated plutonium contamination in the environment around the Dow Chemical Company's Rocky Flats plants near Denver, Colorado. One serious omission is the lack of a thorough evaluation of the soil sampling and analysis procedures used and another the faulty discussion of the ^{239}Pu distribution with depth. Results by other workers are quoted which it is claimed were omitted by Poet and Martell and which tend to refute their conclusion on the extent of the ^{239}Pu spatial contamination. (UK)

15600 OBSERVATION OF RADIOACTIVITY FOR THE PERIOD FROM JANUARY TO DECEMBER 1970. Taiki Hoshano Kansoku Seiseki; No. 54, 1-38(Mar 1972). (In Japanese and English).

Results of routine observations of radioactivity in fallout during the period from January to December 1970 are reported. The observations were made by the network of some twenty stations throughout Japan. The observation of radioactivity in precipitation was carried out when the 24 hour precipitation amount was 1 mm or more until May, and 5 mm or more after June. The precipitation was received with collectors of 25.2 cm bore, settled in the observation field of each station. The collected sample was dried, and gross beta activity was measured with an end window type GM counter with lead shield. Estimated radioactivity in total deposition that was brought to the area of 1 km^{2} of earth's surface by precipitation was calculated by multiplying the observed value by area ratio, and given in mCi per km^{2}. Observation of the radioactivity in airborne dust was carried out three days in a week till May, and once in a week after June, and more frequently following a nuclear explosion. Samples were obtained by filtering air with 96 mm dia paper filters. After reducing the filter papers to ash, measurement of the gross beta activity was performed. For measuring radioactivity in seawater, coprecipitation method was used. Sediment was dried up, and the radioactivity in it was measured with a GM counter. Measurement of ^{90}Sr and ^{137}Cs was carried out by collecting the mixture of precipitation and settled dust by means of a large pan. Results are expressed in mCi per km^{2}. Unusual microbarographic records obtained at the time of eleventh Chinese nuclear test are also reported. (JA)

15601 OBSERVATION OF RADIOACTIVITY FOR THE PERIOD FROM JANUARY TO DECEMBER 1969. Taiki Hoshano Kansoku Seiseki; No. 53, 1-43(Mar 1972). (In Japanese and English).

Results of routine observations of radioactivity in fallout during the period from January to December 1969 are reported. The observations were made by the network of some twenty stations throughout Japan. For the observation of radioactivity in precipitation, precipitation was received with collectors of 25.2 cm bore, settled in the observation field of each station. The collected sample was dried in dishes made of stainless steel, and gross beta activity was measured with an end window type GM counter. Estimated radioactivity in total deposition that was brought to the area of 1 km^{2} of earth's surface by precipitation was calculated by multiplying the observed value by area ratio, and given in mCi per km^{2}. The radioactivity in airborne dust was usually measured three days per week, but under some extraordinary condition such as following a nuclear explosion, measurements were made every day for a certain period. Samples were obtained by filtering air with 96 mm diameter paper filters. After reducing the filter papers to ash, the gross beta activity was measured. The results are shown in pCi per 1 m^{3}. The coprecipitation method was used for measuring radioactivity in seawater. Sediment was dried, and the radioactivity in it was measured with a GM counter. For the collection of a mixture of precipitation and settled dust, fly paper was exposed to the atmosphere. The beta activity of the collected samples was measured. The distribution profile of the radioactivity in the free atmosphere was observed by means of radiosonde. Measurement of ^{90}Sr and ^{137}Cs was performed by collecting the mixture of precipitation and settled dust by means of a large pan. Unusual microbarographic records due to a nuclear test are also reported. (JA)

15602 RELATION BETWEEN ^{90}Sr IN THE STRATOSPHERE AND ITS DEPOSITION ON THE EARTH'S SURFACE. Malakhov, S. G. Tr., Inst. Eksp. Meteorol.; No. 1, 15-26(1972). (In Russian).

Literature data were analyzed for ^{90}Sr concentrations in the lower atmosphere and fallout in the northern and southern hemispheres from 1959 to 1969. A relation was established between ^{90}Sr in the stratosphere at the beginning of the year and the annual fallout rate of this isotope as a function of latitude and between the total ^{90}Sr fallout in both hemispheres and density of fallout of this isotope in different latitudes (in 10° bands). There was little change in the values from year to year. The half-life of ^{90}Sr from the stratosphere of the northern and southern hemispheres from 1963 to 1969 was estimated as 10 months. (tr-auth)

Atmosphere

Refer also to abstracts 15317, 15690, and 16633–16636.

15603 (AERE-R-7540) RADIOACTIVE FALLOUT IN AIR AND RAIN: RESULTS TO THE MIDDLE OF 1973. Cambray, R. S.; Fisher, E. M. R.; Parker, A.; Peirson, D. H. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). Dec 1973. 48p. Dep. NTIS (U. S. Sales Only) $4.50. UK £1.00.

Samples of atmospheric dust and rainwater have been collected from the United Kingdom and elsewhere. Results are presented of analyses of these samples for various fission products and certain other radionuclides. The average concentrations of the long-lived fission products ^{137}Cs and ^{90}Sr were, in the first six months of 1973, less than half those for the first six months of 1972 and less than 2% of the maximum which was reached in 1963/64. Fresh activity from the high-yield Chinese explosion of 27 June 1973 was detected in the United Kingdom in July. Short-lived activity from this explosion had fallen below the limit of detection by mid-September. There was little immediate effect on the levels of long-lived activity: presumably any increase has been delayed until 1974. In the southern hemisphere the low-yield French test series of July and August 1973 has had negligible effect upon the levels of long-

lived fission products near the ground. Short-lived activity was detectable during August at concentrations that were generally about half those from the previous test series of 1972; by September short-lived activity in the air had fallen below the limit of detection. An estimate is made of the worldwide deposit of ^{137}Cs and ^{90}Sr in rain to the end of 1972; the cumulative deposit has remained substantially constant since 1966. About three-quarters of the total long-lived activity has been deposited in the northern hemisphere. The gamma and beta dose rates in air from fallout at Chilton are estimated from the observed deposition. (auth)

15604 (HW-76525-1) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR JANUARY 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Feb 1963. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

The following radiological data are tabulated for the Hanford environs for January 1963, and for the Columbia River for mid-December 1962, to mid-January 1963: reactor effluents and the Columbia River; percentage of MPC in Columbia River water; percentage of MPC in sanitary water derived from the Columbia River; estimated dose in millirem to GI tract from drinking water; estimated rate of transport of selected radionuclides by the Columbia River; and average concentration of ^{32}P in whitefish. The following data relating to radionuclides in the environment from separation facilities and world-wide fallout are tabulated: separations facilities stack emissions of ^{131}I; concentrations of ^{131}I in air; average concentrations of ^{131}I in milk; external radiation; beta activity in air; and chemical properties of Columbia River water. (HLW)

15605 (HW-76525-2) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR FEBRUARY 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 11 Mar 1963. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

The following radiological data are tabulated for the Hanford environs for February 1963, and for the Columbia River for mid-January to mid-February 1963: reactor effluents and the Columbia River; percentage of MPC in Columbia River water; percentage of MPC in sanitary water derived from the Columbia River; estimated dose in millrem to GI tract from drinking water; estimated rate of transport of selected radionuclides by the Columbia River; and concentration of ^{32}P in whitefish. The following data relating to radionuclides in the environment from separation facilities and world-wide fallout are tabulated: separations facilities stack emissions of ^{131}I; concentrations of ^{131}I in air; average concentrations of ^{131}I in milk; external radiation; beta activity in air; and chemical characteristics of Columbia River water. (HLW)

15606 (HW-76525-3) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR MARCH 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 11 Apr 1963. Contract AT(45-1)-1350. 7p. Dep. NTIS $3.00.

The following radiological data are tabulated for the Hanford environs for March 1963, and for the Columbia River for mid-February to mid-March 1963: reactor effluents and the Columbia River; percentage of MPC in Columbia River water; percentage of MPC in sanitary water derived from the Columbia River; estimated dose in millirem to GI tract from drinking water; estimated rate of transport of selected radionuclides by the Columbia River; and average concentration of ^{32}P in whitefish. The following data relating to radionuclides in the environment from separation facilities and world-wide fallout are tabulated: separations facilities stack emissions of ^{131}I; concentrations of ^{131}I in air; average concentrations of ^{131}I in milk; external radiation; beta activity in air; and chemical characteristics of Columbia River water. (HLW)

15607 (HW-76525-4) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR APRIL 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 13 May 1963. Contract AT(45-1)-1350. 7p. Dep. NTIS $3.00.

The following radiological data are tabulated for the Hanford environs for April 1963, and for the Columbia River for mid-March to mid-April 1963: reactor effluents and the Columbia River; percentage of MPC in Columbia River water; percentage of MPC in sanitary water derived from the Columbia River; estimated dose in millirem to GI tract from drinking water; estimated rate of transport of selected radionuclides by the Columbia River; and ^{32}P in whitefish. The following data relating to radionuclides in the environment from separation facilities and world-wide fallout are tabulated: separations facilities stack emissions of ^{131}I; concentrations of ^{131}I in air; average concentrations of ^{131}I in milk; external radiation; beta activity in air; and chemical characteristics of Columbia River water. (HLW)

15608 (HW-76525-5) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR MAY 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 13 Jun 1963. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

The following radiological data are tabulated for the Hanford environs for May 1963, and for the Columbia River for mid-April to mid-May 1963: reactor effluents and the Columbia River; percentage of MPC in Columbia River water; percentage of MPC in sanitary water derived from the Columbia River; estimated dose in millirem to GI tract from drinking water; and estimated rate of transport of selected radionuclides by the Columbia River. Radiation doses were estimated using routine water analyses and activity pulse following release of fission products to the river following a reactor fuel element failure. Average concentrations of ^{32}P in whitefish are reported. The following data relating to radionuclides in the environment from separation facilities and world-wide fallout are tabulated: separations facilities stack emissions of ^{131}I; concentrations of ^{131}I in air; average concentrations of ^{131}I in milk; external radiation; beta activity in air; and chemical characteristics of Columbia River water. (HLW)

15609 (HW-76525-6) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR JUNE 1963. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Jul 1963. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

The following radiological data are tabulated for the Hanford environs for June 1963, and for the Columbia River for mid-May to mid-June 1963: reactor effluents and the Columbia River; percentage of MPC in Columbia River water; percentage of MPC in sanitary water derived from the Columbia River; estimated dose in millirem to the GI tract from drinking water; estimated rate of transport of selected radionuclides by the Columbia River; and average concentration of ^{32}P in whitefish. The following data relating to radionuclides in the environment from separation facilities and world-wide fallout are tabulated: separations facilities stack emissions of ^{131}I; concentrations of ^{131}I in air; average concentrations of ^{131}I in milk; external radiation; beta activity in air; and chemical characteristics of Columbia River water. (HLW)

15610 (INIS-mf-887, pp 128-140) EFFECT OF TRADITIONAL INDUSTRIES ON ENVIRONMENTAL CONTAMINATION WITH RADIUM-226. Jaworowski, Z.; Kownecka, L.; Wlodeck, S. (Centralne Lab. Ochrony Radiologicznej, Warsaw). [nd]. (In Russian).

The concentration of ^{226}Ra was investigated in the Warsaw region in atmospheric precipitations to find out whether the radionuclide can be used as an indicator of environmental contamination with industrial discharges. Experiments showed that the application of the radionuclide in monitoring contamination by traditional industries was not feasible due to a number of errors. In another series of experiments the concentration was studied of ^{226}Ra in vegetables in three areas in Poland with a different degree of industrialization. It was ascertained that in highly industrialized areas, such as Silesia, the concentration of the radionuclide in the types of vegetable studied was significantly higher than in less industrialized areas. (INIS)

15611 (INIS-mf-887, pp 221-234) CONTAMINATION WITH TRITIUM OF NUCLEAR POWER REACTOR ENVIRONMENT. Povinec, P. (Komenskeho Univerzita, Bratislava). [nd]. (In Slovak).

The risks are discussed of tritium contamination of the environment of nuclear power reactors and the respective effects of tritium on the human organism are listed. The reactions resulting in tritium production during the operation of nuclear power reactors are briefly discussed. The release of tritium and the transport of tritium from the atmosphere to the hydrosphere and the biosphere are dealt with. (INIS)

15612 (NERC-LV-539-504) NOBLE GAS SURVEILLANCE NETWORK, APRIL 1972-MARCH 1973. Andrews, V. E.; Wruble, D. T. (National Environmental Research Center, Las Vegas, Nev. (USA)). Sep 1973. Contract AT(20-1)-539. 21p. (CONF-730915-11). Dep. NTIS $3.25.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

One year of operation of the continuous noble gas sampling network to monitor the nuclear testing activities at the Nevada Test Site (NTS) demonstrated success in producing a workable sampling system and in measuring ambient concentrations of ^{85}Kr and ^{133}Xe. Failure of several sampler components to meet specifications resulted in a large number of sampler malfunctions during the first few months. Replacement with suitable parts resulted in greatly improved reliability. Although insufficient data is available to predict background concentrations of ^{85}Kr as a function of time of year and minimum detectable increase above background for a single

sample, it is anticipated that such information will be available after another year of operation. Statistical analysis of the ^{85}Kr data indicates that although no individual samples could be said to be above background, average concentrations in surface air at the NTS were above those off-site. Average concentrations north of the NTS were not significantly different than those to the south for the entire year or for summer and winter seasons. The conclusion is that low-level releases of ^{85}Kr occur at NTS which are detectable on-site, but which do not result in measureably increased concentrations in the off-site area. Measurable concentrations of ^{133}Xe were collected at off-site stations five times during the year. The maximum concentration of ^{133}Xe measured off-site was less than 1 percent of the radioactivity concentration guide for exposure to a suitable sample of the population. (CH)

15613 ATMOSPHERIC RADON AND DUST. Air Mass Trajectories and Meteorological Conditions Over the Greenland Sea. Bressan, D. J.; Larson, R. E.; Wilkniss, P. E. (Naval Research Lab., Washington, DC). Nature (London) Phys. Sci.; 245: No. 144, 74-77(1 Oct 1973).

A discussion is presented on some measurements made in August 1971 on ^{222}Rn, CO, CH_4, and continental dust over the Norwegian and Greenland sea, together with further measurements made a year later from the U. S. Naval Research Laboratory ship Mizar. The earlier measurements were compared with air mass trajectories obtained from synoptic weather charts to show the validity of this approach in studying atmospheric transport phenomena of continental air waves over the Arctic seas. (UK)

15614 SAMPLE PREPARATION OF ATMOSPHERIC AEROSOLS WITH REGARD TO THEIR EVALUATION AND TO SYSTEMATIC RADIOACTIVITY MONITORING. Hemon, G.; Pannetier, R.; Philippot, J. C. (CEN de Saclay, Gif-sur-Yvette, France). Staub-Reinhalt. Luft; 33: No. 10, 401-405(1973). (In German).

Some sample preparation methods for systematic radiation monitoring (α-, β- and γ-radiation) are discussed. For aerosol sampling, the filter Microsorban is used that consists of polystyrene fibers. This material can be processed in a simple manner suitable for each type of radiation. The discussed preparation methods permit an adaption of the sample shape on the used electronic measuring devices and a good automation of radiation detection and its evaluation. (GE)

15615 RELATIVE SENSITIVITY OF MEASURING METHODS FOR RADIOACTIVE WASTES IN AIR AND WATER. Boulenger, R. (CEN, Mol, Belgium). J. Belge Radiol.; 56: No. 5, 439-441 (1973). (In French).

The relative sensitivity of measurement of radioactive wastes in air and in water was studied. It is shown that the sensitivity of the methods of measurements allows the detection of small fractions of the environmental radioactivity level. (auth)

15616 ATMOSPHERIC CONCENTRATIONS AND SOURCES OF TRACE METALS AT THE SOUTH POLE. Zoller, W. H. (Univ. of Maryland, College Park); Gladney, E. S.; Duce, R. A. Science; 183: No. 4121, 198-200(18 Jan 1974).

The chemical composition of atmospheric particulate material collected at the geographic South Pole indicates that Al, Sc, Th, Sm, V, Mn, Eu, Fe, La, Ce, Co, Cr, Na, K, Mg, and Ca are derived from either crustal weathering or the ocean. The relatively volatile elements Zn, Cu, Sb, Se, Pb, and Br are apparently derived from other sources. Because of their volatility, vapor-phase condensation or a high-temperature dispersion source is suspected for these elements or their compounds. (auth)

15617 BOMB-PRODUCED TRITIUM IN THE ANTARCTIC OCEAN. Michel, R.; Williams, P. M. (Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 20: No. 3, 381-384(Nov 1973).

Tritium measurements for twenty-four samples from the Antarctic Ocean are given. Results are discussed with respect to water mass types and previous measurements. High tritium concentrations are found in certain deep water masses, indicating an input of surface water into these masses in the last ten to twenty years. (auth)

15618 WORLD-WIDE CONTAMINATION OF THE ATMOSPHERE WITH ^{85}Kr FROM PEACEFUL USES OF NUCLEAR ENERGY. Korol, I. L.; Ivanov, V. I.; Kolobashkin, V. M.; Leipunskii, O. I.; Nekrasov, V. I. Tr., Inst. Eksp. Meteorol.; No. 1, 27-40(1972). (In Russian).

Average annual and seasonal concentrations of ^{85}Kr released from atomic electric stations were calculated for the troposphere and lower stratosphere by numerical integration of model equations of planetary transfer for a continuous surface source in temperature latitudes. A comparison of calculated and measured isotope concentrations in the lower atmosphere is shown chiefly for the temperate latitudes of the northern hemisphere. A difference was noted in the calculated concentrations in the northern and southern hemispheres. Expected worldwide distributions of ^{85}Kr due to peaceful uses of nuclear energy to the year 2000 are discussed. (tr-auth)

15619 DISTRIBUTION OF RADON, ATMOSPHERIC DUSTS, AND FISSION PRODUCTS IN THE LOWER ATMOSPHERE OVER THE ATLANTIC OCEAN AS A FUNCTION OF THE LOCATION OF THE INTERTROPICAL ZONE OF CONVERGENCE. Belen'kii, V. S.; Krasnopevtsev, Yu. V.; Malakhov, S. G. Tr., Inst. Eksp. Meteorol.; No. 1, 40-45(1972). (In Russian).

Measurements are given of the concentration of radon decay products, total beta-active fission products, and dusts in the lower atmosphere along the 30° meridian in April-May 1970, over the Atlantic Ocean. As the ship passed into the intertropical zone of convergence, the concentration of dusts and fission products changed abruptly, sometimes by more than an order of magnitude. The change in concentration of the radon decay products was smoother. A hypothesis is formulated concerning the use of measurements of radon decay products, dusts, and products of nuclear explosions to determine the intertropical convergence zone. (tr-auth)

15620 EFFECT OF ADVECTION OF AIR MASSES ON CHANGE IN CONCENTRATION OF ^{210}Pb AND FISSION PRODUCTS IN THE LOWER ATMOSPHERE IN THE KIROV REGION. Malakhov, S. G.; Trufakin, V. A. Tr., Inst. Eksp. Meteorol.; No. 1, 68-72(1972). (In Russian).

Measurements of ^{210}Pb and ^{90}Sr in the lower atmosphere of the Kirov region are reported for the period from 1967 to 1970 as a function of the advection of air masses from different geographical regions. It is shown that as air masses move from the Ledovit area or the Atlantic Ocean, the ^{210}Pb in the lower atmosphere decreases compared to that over Central Eurasia. A similar but less marked dependence was observed for the ^{90}Sr concentration. (tr-auth)

15621 EVALUATION OF INTER-LATITUDINAL MACROTURBULENT TRANSFER IN THE DISTRIBUTION OF RADIOACTIVE TUNGSTEN IN THE LOWER STRATOSPHERE. Karol, I. L.; Kolesnikova, L. V. Tr., Inst. Eksp. Meteorol.; No. 1, 73-89(1972). (In Russian).

Measurements, made from an aeroplane, of ^{185}W concentrations in the lower stratosphere during September 1958 to October 1959 and measurements of fallout made at the whole network of stations showed mid-regional inter-latitudinal currents of isotopes in the stratosphere at levels up to 20 to 22 km. Macroturbulent and ordered components of the currents were separated, and the coefficients of inter-latitudinal macroturbulent diffusion were evaluated and averaged for the region 70°N to 50°S latitude. These values are compared with statistical characteristics of the components of the wind velocity in the lower stratosphere in 1958. (tr-auth)

15622 MODELING THE VERTICAL DISTRIBUTION OF POLYDISPERSED STRATOSPHERIC AEROSOLS. Karol, I. L. Tr., Inst. Eksp. Meteorol.; No. 1, 89-97(1972). (In Russian).

Published measurements of the distribution in the lower stratosphere of particles according to size were analyzed. Two variants are proposed for approximate substitution of transfer of a monodispersed aerosol for that of a polydispersed aerosol in mathematical models: variant with the weighted average, depending on the size range, by the rate of gravitational precipitation; variant with the value of the rate for maximum density of the spectrum of particle size. The evaluation of the error of such a substitution for the simple case of vertical turbulent diffusion of radioactive aerosols in the stratosphere showed a high precision of the first variant. (tr-auth)

15623 PATTERNS OF WORLD-WIDE RADIOACTIVE FALLOUT FROM THE ATMOSPHERE IN 1967-1969. Malakhov, S. G.; Silant'ev, A. N.; Churkin, V. N.; Bobovnikova, Ts. I.; Gaziev, Ya. I.; Nazarov, L. E.; Makhon'ko, K. P.; Martynenko, V. P.; Polyakova, T. V.; Vasil'ev, A. S.; Reut, G. M. Tr., Inst. Eksp. Meteorol.; No. 1, 3-14(1972). (In Russian).

Average monthly concentrations of ^{144}Ce, $^{95}Zr + {}^{95}Nb$, ^{137}Cs, ^{90}Sr, and ^{141}Ce in the atmosphere near the earth's surface and quarterly fallout of these isotopes in the USSR from 1967 to 1969 are reported. Average yearly levels of radioactive contaminants in the lower atmosphere and fallout of long-lived isotopes were approximately the same. The maximum ^{137}Cs concentrations in the lower atmosphere after the nuclear explosions of both June 17, 1967 and Dec. 28, 1968 (1 mCi in the stratosphere) were reached in the summer of the following year and were approximately the same. Products from the explosions carried out in the southern hemisphere during July to Sept. 1968 were observed in the USSR during Aug. to Oct. Data obtained from airplane measurements showed a maximum beta activity after the Dec. 28, 1968 explosion

in the upper troposphere (6–9 km) several months earlier than in the lower troposphere and in the air near the earth's surface. (tr-auth)

15624 METHOD FOR RADIOGRAPHY OF ASH RESIDUES OF SAMPLES OF ATMOSPHERIC AEROSOLS. Gaziev, Ya. I. Tr., Inst. Eksp. Meteorol.; No. 1, 117-122(1972). (In Russian).

A method is described for the radiography of ash residues of aerosol samples to determine the atmospheric content of "hot" radioactive particles. The aerosol samples were collected on gauze planchettes and filtered. The samples were calcined in a muffle furnace at a temperature no greater than 500°C. The ash residues of the samples in a mixture with vacuum oil were transferred to tracing paper and radiographed, using x-ray film. The gauze planchettes and filters were calcined to concentrate the samples of radioactive particles. (tr-auth)

Soil

Refer also to abstracts 15549–15552.

15625 (INIS-mf-715) TESTS FOR LIMITING THE PENETRATION OF ^{90}Sr FROM THE SOIL INTO PLANTS. Rajkov, L. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 22p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The assimilation of ^{90}Sr introduced in the soil by the plants is studied in pot experiments. A total of 15 soils, including the basic soil varieties in this country were tested. Significant differences were established in the desorption of ^{90}Sr of the separate soils. With five widely distributed soils (carbonate chernozem, smolnitza, bleached chernozem, podzolized cinnamon forest soil, and brown forest soil) tests are carried out with chemicals and fertilizers for blocking the assimilation of ^{90}Sr by plants. Tests were conducted with $Ca(H_2PO_4)_2$, K_2PHO_4, $CaCO_3$, and manure in growing oats, peas, and alfalfa. As a result of investigations it was established that plants grown on brown forest soil, podzolized cinnamon forest soil, and on alluvial soils assimilate many times more ^{90}Sr than plants grown on chernozem soil and particularly on smolnitza soil. This is related to differences in the mechanical composition, the sorption capacity, pH of the soil, and other factors. Most strong and permanent is the blocking effect of K_2HPO_4. Significant blocking effect was also obtained by $Ca(H_2PO_4)_2$ while such effect by $CaCO_3$ and manure was observed only in acid soils. The dependences established were observed in cereals and leguminous plants but certain differences exist in their absolute values as well as in the straw and grain of the separate crops. (auth)

15626 (INIS-mf-716) POLLUTION OF MOUNTAIN SOILS WITH RADIOACTIVE STRONTIUM AND CESIUM. Rajkov, L.; Najdenov, M.; Darkova, St. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 14p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

During investigations of the mountain soils in this country (brown forest soils and mountain-meadow soils) a considerably higher accumulation of fallout products was established as compared to soils in the plains. Studies were conducted on the ^{90}Sr and ^{137}Cs content in soils of different altitude as well as on the ^{90}Sr content in the natural vegetation of separate regions. The ^{90}Sr content was determined radiochemically and that of ^{137}Cs radiometrically with a gamma analyser and specially constructed camera. It was established that from 80 to 90% of the Sr accumulated in the soil was absorbed comparatively firmly by the surface layers from 0 to 3 cm deep. The penetration of this element in the layers from 3 to 10 cm deep is in small amounts and in the layers from 10 to 20 cm is encountered only as an exception. The picture of ^{137}Cs content and distribution in the same soils is similar. Expressed in absolute units (pCi/g soil) the content of ^{137}Cs is higher than that of ^{90}Sr. The increase of the beta activity in the surface layers of virgin soils investigated as a result of deposition of fallout products exceeds 5 to 6 times the natural beta activity of the same soils (for the period 1964-1970). (INIS)

15627 (INIS-mf-719) INTENSITY AND SPECTRAL ANALYSIS OF GAMMA RADIATION FROM NATURAL RADIONUCLIDES IN MOUNTAIN SOILS. Dimchev, T.; Rajkov, L. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 13p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Nondestructive semi-quantitative gamma-spectrometric analysis of natural radionuclides in forest soils was conducted with the aid of a sensitive low-background gamma scintillation spectrometer. Investigations were carried out on the distribution and relative intensity of the gamma lines resulting from the emitters of the uranium and thorium order. The gamma spectra were surveyed as additional characteristics of different soils related to the content and migration of certain heavy elements and the soil-forming rocks. (INIS)

15628 (INIS-mf-766-5, pp 601-614) HAZARDS OF SHORT-LIVED RADON DAUGHTERS IN CZECHOSLOVAK NONURANIUM MINES. Cech, J. (Ustav Hygieny Prace Uranoveho Prumyslu, Kamenna, Czech.). [nd]. (In Czech).

The results are briefly presented of the investigation of radon content in selected uranium ore and coal mines in Czechoslovakia between the years 1961 and 1971. Mines were found where the radon content exceeded the maximum permissible concentration or was close to it. The study into the radiation hazards to miners shows that annual exposures within limits set for uranium mines, i.e. 4×10^4 MeV/l of potential α energy of radon daughters, might not, even after the life-long occupational exposure, affect the natural incidence of lung cancer in miners. It shows, however, that safety regulations valid for uranium mines should also be applied to coal and other mines and that better dosimetric control and mine ventilation systems should be ensured. (INIS)

15629 (INIS-mf-887, pp 252-265) MATHEMATICAL MODELLING OF RADIONUCLIDE MIGRATION IN CERTAIN REGIONS OF BIOSPHERE. Prokhorov, V. M. [nd]. (In Russian).

Mathematical relationships are derived and the models are elaborated for the radionuclide absorption by the bottoms of water basins, for the vertical migration of radionuclides in soils, for the root absorption of radionuclides by plants from soils, and for the migration of radionuclides in forest flora. ^{90}Sr was taken as a typical representative of the radionuclides. (INIS)

15630 (LIB/TRANS-507) MECHANISMS OF TRANSFER IN CULTIVATED SOILS OF RADIONUCLIDES DISCHARGED BY ELECTRONUCLEAR POWER STATIONS IN THE RIVER STREAM–IRRIGATED SOILS–WATER BED SYSTEM. Saas, A.; Grauby, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Dept. de Protection). Jun 1973. Translation of SM-172-57. 27p. Dep. NTIS (U.S. Sales Only) $3.50.

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973).

The location of electro-nuclear power plants along river banks whose waters are used for irrigation and domestic consumption necessitates a thorough investigation of transfer mechanisms within the river/irrigated soil/water bed system. Mechanisms of transfer were examined from the following standpoints: the effect of the water quality of the river, irrigation channels, and water beds on mobility of radionuclides; the effects of soil type; and distribution of water-soluble and more labile forms of radionuclides in the soil. The study was concerned with ^{22}Na, ^{137}Cs, ^{85}Sr, ^{54}Mn, ^{59}Fe, ^{60}Co, ^{65}Zn, ^{124}Sb, ^{141}Ce, and ^{131}I. Hazards of contamination in relation to transfer mechanisms were examined and the behavior of radionuclides as a function of organic-mineral pollution originating from industrial sources was investigated. (HLW)

15631 (UCRL-75325) Ge(Li) LOW LEVEL IN-SITU GAMMA-RAY SPECTROMETER APPLICATIONS. Phelps, P. L.; Anspaugh, L. R.; Roth, S. J.; Huckabay, G. W.; Sawyer, D. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Dec 1973. 20p. (CONF-731112-24). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Currently a Ge(Li) spectrometer is being employed for in-situ measurements of radionuclides contained in soil. This is being done at nuclear reactor sites and in complex radionuclide fields at the Nevada Test Site. The methodology and precision of the in-situ spectrometric technique was previously established for analysis of radionuclides in soil. Application of the technique to gaseous and liquid effluents containing radionuclides has shown a great deal of promise. (auth)

15632 RADIOECOLOGICAL STUDY OF STRONTIUM-90 IN OSAKA DISTRICT, JAPAN. Nagayama, S.; Nagasawa, M.; Teraguchi, T.; Matsumoto, S. (Osaka Prefectural Univ., Sakai, Japan). Bull. Univ. Osaka Prefect., Ser. A; 21: No. 2, 331-338 (Mar 1973).

Studies were undertaken to clarify the monthly depositions and vertical distributions of ^{90}Sr in soils and runoff of ^{90}Sr by river to

sea. In Osaka Prefecture, monthly depositions of ^{90}Sr were determined during 1963 to 1970. From 1958 to 1968, annual variations of ^{90}Sr concentration in the waters of the Yodogawa and Yamatogawa Rivers were shown, and the maximum value (1.5 $\mu\mu c/l$) of ^{90}Sr concentrations in waters was found in 1963. From 1963 to 1968, 74 to 79% of total ^{90}Sr in undisturbed soils was included in depth 0 to 6 cm. ^{90}Sr concentration in river water is given by $C = 0.5\ R + 0.01\ D$, where C is ^{90}Sr concentration ($\mu\mu c/l$) in river water, R is the amount of ^{90}Sr deposition (mCi/km^2) during three months before sampling of water, and D is that of cumulative ground deposit (mCi/km^2) of ^{90}Sr before sampling of water. (JA)

15633 SELECTION OF A SITE FOR THE GROUND DISPOSAL OF RADIOACTIVE WASTES. 4. Migration of Multiple Nuclides Under the Ground. Morisawa, S. (Kyoto Univ.). Nippon Genshiryoku Gakkaishi; 15: No. 7, 503-508(Jul 1973). (In Japanese).

The migration of single radionuclides disposed of underground has been studied extensively, and many results have been reported. The migration of multiple radionuclides under similar conditions, has, on the other hand, scarcely been studied, and yet it is very important for evaluating the safety of the ground disposal of radioactive wastes. A discussion is presented on two theories (that of frontal analysis proposed by Sillen & Inoue's theory) on the behavior of multiple nuclides. It is shown that frontal analysis is applicable theoretically to the estimation of the migration of multiple radionuclides, but that some difficulties are encountered in its practical use in the field. The difficulties are, for instance, the estimation of the quantities of soil in contact with underground water, and the effect of the diffusion of the nuclides in the underground water. Inoue's theory, on the other hand, well depicts the migration of multiple radionuclides under the ground, but the theory requires field observation of the ground water movement. (auth)

15634 CONTENTS OF ^{137}Cs IN DIFFERENT SOILS AS A BASIS FOR PRECISELY DIRECTED RESEARCH OF THE ^{137}Cs CONTAMINATION OF FOODSTUFFS OF ANIMAL ORIGIN. Hebel, R. (Staatliches Veterinaeruntersuchungsamt, Krefeld, Ger.). Deut. Tieraerztl. Wochenschr.; 80: No. 17, 404-408 (Sep 1973). (In German).

By means of 156 samples from crater lakes of the Eifel, the ^{137}Cs-activity of various types of soil as well as the vertical and lateral distribution of ^{137}Cs in the soil were examined. Moreover, the content of potassium, the percentage of the organic substance, and the pH-value were determined. The reading of ^{137}Cs and potassium was obtained by gamma spectrometry in ring cups, the contents of organic ingredients was ascertained via the carbon proportion, and the pH-value by means of a glass electrode. The content and extent of penetration of ^{137}Cs correlate with the proportion of organic substance, the content of potassium and the pH-value. Nevertheless there exists no causal dependence between these values. It seems that causal significance for the contents, the extent of penetration and the lateral distribution has to be attributed to the surface water, the texture, and the absorbent qualities of the soils as well as the topography of the region. The importance of the knowledge of the behavior of ^{137}Cs in the soil in view of prophylaxis and single-minded taking of samples for the estimation and the reduction of the ^{137}Cs content of slaughtered cattle is pointed out. (GE)

15635 ENVIRONMENTAL RADIOACTIVITY IN THE EUGANEAN THERMAL BASIN. Calapaj, G. G.; Ongaro, D. (Univ., Padua). G. Fis. Sanit. Prot. Radiaz.; 16: No. 3, 131-144(1972). (In Italian).

The Euganean basin (near Padua) is well-known for the therapeutic effect of its waters and muds. Radium-226 and radon with its descendents are present in noticeable quantity in both waters and muds particularly in these latter. Waters at high temperature are drawn from artificial wells; whereas muds are prepared by soaking a local blue clay in thermal water. Ripening of mud is assisted by the growth of macro- and microalgae and takes about 3 to 5 yr. Mud ^{226}Ra content ranges from 4500 to 42,000 pC/kg wet weight and concentration factor for the ^{226}Ra in waters may reach a value of 2000 or more. Surface and deep gamma dose rates in masses of mud from 5 to 10 m^3 however, range from 80 to 90 $\mu R/h$, due to the fine dispersion of the sources and the self-absorption of the gamma rays. Experimental data support the theoretically advanced view that workers and attendants are not subjected to particular genetic or somatic risk. Demographic evidence was sought in the form of a comparison between malignant tumor mortality rates of the Euganean area and the Province of Padua, and between the same rates of the mud therapy employees and the common population in such area. No significant differences could be detected in either case. (auth)

15636 PREPARATION AND TESTING OF STANDARD SOILS CONTAINING KNOWN QUANTITIES OF RADIONUCLIDES. Sill, C. W.; Hindman, F. D. (Atomic Energy Commission, Idaho Falls, ID). Anal. Chem.; 46: No. 1, 113-118(Jan 1974).

A general procedure for preparation of standard soils containing a known quantity of any given radionuclide is described. Four separate standards have been prepared from three different soils using plutonium-239 to demonstrate the reproducibility and reliability of the procedure. Extensive analyses using plutonium-236 tracer show that the standards contain the exact concentration calculated to have been added, that they are not detectably inhomogeneous on samples as small as 1 g, and that homogeneous standards of lower concentrations can be prepared exactly by weight dilutions with the unspiked soils. Of a total of 56 determinations made on 1- and 10-g aliquots of the four individually spiked standards and two others made by dilution, only four determinations showed distinct signs of inhomogeneity with the particular method of preparation and sample size employed. Of the remaining 52 measurements, all agreed with the calculated value within three standard deviations of the determination, and 42 were within two standard deviations. The dramatic effect of heat treatment on the leachability of the plutonium is demonstrated. Also, an alternative method for preparation of solid standards for members of the natural uranium and thorium series is suggested. (auth)

15637 CHEMICAL MANIPULATION OF SOIL BIOTA IN A FESCUE MEADOW. Malone, C. R.; Reichle, D. E. (Oak Ridge National Lab., TN). Soil Biol. Biochem.; 5: 629-639(1973).

Formalin, phorate, and sodium chlorate were used in field enclosures to create artificial habitats in a fescue meadow containing reduced number of earthworms, reduced numbers of earthworms and soil arthropods, and reduction of total soil fauna and rate of microbial decomposition. Under these conditions, confined fescue litter initially decomposed more rapidly where arthropods or earthworms were suppressed than in controls with full complements of soil animals. After one year, reduction in numbers of soil animals had no net effect on litter decomposition, with faunal activity apparently having been compensated for by increased microbial activity. Where animals and microbial activity were reduced, rate of litter loss was depressed initially but recovered after 10 months as the effects of chemical suppression of microbial populations subsided. Contrary to the effects on annual loss of litter, elimination of all or portions of the soil fauna depressed rates of loss of confined and buried roots, reflecting the role of animals in fragmenting roots before their decomposition by microorganisms. Habitat manipulations had pronounced effects on the mobility of ^{134}Cs, and loss of the radionuclide from labeled litter was retarded despite an accelerated rate of decomposition. This effect apparently was associated with proliferation of microorganisms on litter and microbial immobilization of the radionuclide. Immobilization of ^{134}Cs occurred following chemical perturbations, but only after an initial period of rapid loss resulting from increased microbial activity. Distribution of ^{134}Cs in soil beneath tagged litter bags reflected the role of animals in element redistribution within soil. Restricted vertical mobility of the nuclide occurred except where chemical application killed vegetation within the experimental enclosures. (auth)

Water

15638 (JPRS-60685, pp 21-30) DETERMINATION OF ADMISSIBLE RADIOACTIVE POLLUTION IN WATER. Gaspar, E. 4 Dec 1973. Translated from Hidrotehnica; 18: 245-249 (1973). NTIS.

In translations on eastern Europe, scientific affairs No. 371.

Study of the dynamics of radioactive discharges in surface waters points out their tendency to concentrate in living organisms and alluvia. The maximum concentrations permissible for discharge of fission products in surface waters, the maximum concentration permissible in silts and bottom sediments, and the maximum concentration permissible for beaches are calculated. (auth)

15639 LEAD-210 AND POLONIUM-210 IN THE SURFACE WATER OF THE PACIFIC. Tsunogai, S.; Nozaki, Y. (Hokkaido Univ., Hakodate, Japan). Geochem. J. (Nagoya); 5: No. 4, 165-173(Dec 1971).

^{210}Pb and ^{210}Po in sea water of the Pacific were determined and applied to make clear the behavior of lead in the surface water of the ocean. The concentration of ^{210}Pb in the surface water was much smaller than the expected value, if it were soluble in seawater. Its geographical distribution showed a latitudinal variation that presented higher values in both mid-latitudes of the Pacific and lower values in the tropical Pacific and the southern South Pacific. These facts suggest that lead is settling with the velocity of $(1\text{-}5) \times 10^{-4}$ cm/sec in the surface layer. However, it is very unlikely that the lead exists as pure solid phase of lead oxide. The lead probably forms an eutectic solid phase with other host metals such as manganese oxide. The ratios of ^{210}Po to ^{210}Pb

in surface water were larger than those in meteoric precipitation, but most of them were smaller than unity. (auth)

15640 RADIOACTIVITY OF WATERS IN THE VICINITY OF JASLOVSKE BOHUNICE BEFORE STARTUP OF THE NUCLEAR POWER PLANT. Csuoka, S. (Oblastna Hygienicka Stanica, Bratislava). Vod. Hospod., B; No. 7, 183-186(1972). (In Slovak).

Data are presented as a basis of evaluating the increase in activity of waters in the vicinity of Jaslovske Bohunice due to startup of the nuclear power plant. The monitoring of radioactivity of waters on the territory of western Slovakia conducted between 1968 and 1970 showed that the average annual values were constant and that annual fluctuations were due to an increased fallout and to meteorological conditions. (INIS)

15641 DEUTERIUM DISTRIBUTION IN THE GULF OF MEXICO. Frank, D. J. (Texas A and M Univ., College Station). J. Phys. Oceanogr.; 3: 230-236(Apr 1973).

The variations of the stable isotopes of hydrogen (protium and deuterium) were determined in the various water masses of the Gulf of Mexico. Surface waters of the central Gulf were found to have an average $\delta D = 5.6‰$ relative to Standard Mean Ocean Water (SMOW), where $\delta D(‰) = \{[(HD^+/H_2^+)\text{sample}/(HD^+/H_2^+)\text{standard}] - 1\} \times 1000$. The subsurface water masses, Subtropical Underwater, Antarctic Intermediate Water, and Gulf Basin Water, were found to be characterized by deuterium contents of 5.0-5.5, -0.5 and 0.9‰, respectively. In addition, a high deuterium feature ($\delta D = 5.5-6.3‰$) was shown in the water column at about 100-m depth just above Subtropical Underwater. The δD values for the freshwater contribution to the Gulf via the Mississippi and Coatzacoalcos Rivers were found to be -42.3 and -19.3‰, respectively. The value for the net freshwater addition to the Gulf was ~-33‰. The isotopic composition of near-shore waters is consistent with a simple mixing model of fresh water from runoff with ocean water modified by the mixing of sea waters from distinct sources. (auth)

15642 TRITIUM DATA FROM THE GROUND WATER OF THE KRISTIANSTAD PLAIN 1963-1972. Preliminary Report. Persson, G. (Sveriges Geologiska Undersoekning, Stockholm). Vannet Norden; 6: No. 3, 3-17(1973). (In Swedish).

The data presented are part of an investigation begun in 1963 of the tritium content of the ground water of the Kristianstad plain. A more thorough processing of both tritium and supplementary chemical data is planned when analyses over a 15 to 20-year period are available. The data show that no elevated tritium content has yet been found in deep wells with moderate water extraction in the control areas of the limestone district. This indicates that the water in the large ground water reservoir in the cretaceous strata is exchanged very slowly. Under certain circumstances, however, the rate of exchange has increased locally due to pumping, so that younger water with a measurable tritium content has penetrated to the strata from which pumping takes place. This is the case in most shallow and moderately deep wells and also in the deep wells where the water extraction has been very large. The results regarding the ground water exchange on the Kristianstad plain agree well with previous results. (NO)

15643 STATISTICAL TIME STRUCTURE OF THE TOTAL RADIOACTIVE FALLOUT IN THE OCEAN. Vinogradova, K. G.; Zudin, O. S.; Nelepo, B. A.; Trusov, A. G. At. Energ. (USSR); 35: No. 2, 136-138(Aug 1973). (In Russian).

Data are presented for the fallout from 1966 to 1971. Over both the ocean and the dry land, there was a typical summer maximum and winter minimum of artificial radioisotope fallout at the several observation stations used. (MG)

15644 MEASUREMENT OF ^{14}C IN BEPPU HOT SPRING. Oda, T. (Oita Univ., Japan). Oita-ken Onsen Chosa Kenkyu-kai Hokoku; No. 22, 80-83(Mar 1971). (In Japanese).

The concentration of ^{14}C at seven places in the Beppu hot spring region was measured in order to explain the springing mechanism. Water from each hot spring was gathered so as to obtain 5 g or more calcium carbonate, which was concentrated and a sulfuric acid solution was added drop by drop, while the evolving carbon dioxide gas was absorbed into aqueous ammonia. Then a calcium chloride solution was added to precipitate the calcium carbonate, and the precipitate was filtered and dried with an infrared lamp. ^{14}C was measured with a counter. The sample of calcium carbonate was changed into methane gas, which was introduced into a 250 ml counter chamber. Values of $\Delta^{14}C$ were -28.2, -68.5, -33.5, -28.2, -79.9, -100.0 and 5.1 for the seven places, and $\Delta^{14}C$ of air was 37.5. These values were calculated according to the equation $\Delta^{14}C = [(Asamp - 0.95\ Astd)/0.95\ Astd] \times 100‰$, where Asamp is (cpm of sample-cpm of background), and Astd is (cpm of standard-cpm of background). The amount of ^{14}C in hydrocarbonic acid ions in rainwater that has traveled underground for a very long period and thereafter returned to ground surface shows a decrease due to 5,700 years half life decay, whereas ^{14}C was absent in the hydrocarbonic acid ions that had leached out of the rock walls. An important factor affecting $\Delta^{14}C$ seems to be proportion of the carbonic acid ions leached out of rock walls rather than the period of underground retention. (JA)

15645 ^{90}Sr IN THE WATER OF THE NORTHWEST PACIFIC OCEAN IN 1966-1968. Chumichev, V. B. Tr., Inst. Eksp. Meteorol.; No. 1, 45-50(1972). (In Russian).

Results are given of radiochemical determinations of ^{90}Sr in 50 surface samples of seawater and 19 samples taken from depths of from 45 to 300 m in the northwest Pacific Ocean. The average value of the ^{90}Sr concentration in the surface samples during 1966 to 1968 was 0.25 nCi/l, with a mean square error of 0.05 nCi/l, and in the depth samples taken in March 1966, about half this value. The average ^{90}Sr concentration in the depth samples, taken during May to June 1966 and September to October 1968, was the same as in the surface waters. (tr-auth)

15646 RADIOACTIVITY OF THE SEDIMENTS IN THE TARANTO GULF (1969). Triulzi, C. (CISE, Milan); Mezzardi, M. G.; Giacoletto, G. G. Fis. Sanit. Prot. Radiaz.; 16: No. 2, 101-108(1972). (In Italian).

Sediment samples collected (in November 1969) in the Taranto Gulf (Ionian Sea) in front of the Sinni river mouth, were analyzed for ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{147}Pm, ^{155}Eu, ^{60}Co, and ^{125}Sb contents. These samples appear to be slightly contaminated and the data obtained are compared with those concerning zones of other Seas (Ligurian and High Adriatic) along Italian coasts. (auth)

Ecosystems and Food Cycles

Refer also to abstract 15316.

15647 RELATIONSHIPS BETWEEN LEVELS OF RADIOCESIUM IN THE DOMINANT PLANTS AND ARTHROPODS IN A CONTAMINATED STREAM-BED COMMUNITY. Anderson, G. E.; Gentry, J. B.; Smith, M. H. (Savannah River Ecology Lab., Aiken, SC). Oikos; 24: No. 9, 165-170(1973).

Radiocesium concentrations in several groups of plants and arthropods were measured on the small islands and floodplain of a stream bed contaminated with radioactive wastes. Mean cesium concentrations were significantly higher on the islands than on floodplain areas. There were no consistent trends for increasing or decreasing concentration across trophic levels. However, the degree of linear correlation between radiocesium concentrations in different types of plants and arthropods was significant and makes possible a model to predict radiocesium levels in other components of the system. Predictability was highest between the various arthropod groups and lowest among the different plant types. Between two possible producer-herbivore-predator associations (broomsedge-grasshopper-spider, and broomsedge-leafhopper-spider) radiocesium concentrations ratios differed significantly. (auth)

15648 SELECTION OF A GROUND DISPOSAL SITE FOR RADIOACTIVE WASTES: AN APPROACH TO ITS SAFETY EVALUATION. Inoue, Y.; Morisawa, S. (Kyoto Univ.). Health Phys.; 26: No. 1, 53-63(Jan 1974).

The disposal of radioactive solids or solidified wastes in the ground is not allowed in Japan mainly because of the difficulties in estimating the migration of escaped radionuclides and their effect on the human body (internal dose). In this report, the action of radionuclides in an environment is quantified, and the dose rate of internal irradiation is estimated. Ten radionuclides contained in radioactive wastes (^{137}Cs, ^{90}Sr, ^{58}Co, ^{60}Co, ^{54}Mn, ^{59}Fe, ^{110m}Ag, ^{65}Zn, ^{99}Mo, ^{131}I) and three paths of flow by which they have escaped into the ground to migrate in an environment, i.e., the paths of drinking water, sea foods, and vegetables, are discussed. It is concluded that (1) the most dangerous nuclides in this method of disposal are ^{90}Sr and ^{110m}Ag, (2) the largest internal dose is absorbed through the intake of vegetables, (3) the method of ground disposal of radioactive wastes appears to be safe and promising because of the low internal dose estimated, and (4) the method of estimation discussed is also applicable to other problems of the same type such as the sanitary land-fill of industrial wastes. (auth)

15649 DEPOSITION OF IODINE ON GRASS AND CLOVER. Heinemann, K. (Kernforschungsanlage, Juelich, Ger.); Stoeppler, M.; Vogt, K. J.; Angeletti, L. (1973). vp. (In German).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

The deposition of iodine on grass and clover was investigated by varying both meteorological and biological parameters. The experimental results can be represented by an empirical equation for the deposition rate, which uses as linear factors a meteorological parameter, the vegetation on the given area (dry matter), and a further "biological parameter" that is as-

sumed to cover the age of the grass plants and the growth period. Some data are given describing this biological parameter. Furthermore, the half-life of iodine on grass was determined in order to describe desorption effects. Sunshine and rainfall were found to have no effect on the biological half-life. The influence of the chemical type of iodine on the deposition rate (fallout constant) was also determined. A newly developed catalytic procedure was used for the outdoor experiments that could not be made with ^{131}I in order to determine the natural iodine content of the plants. This method is sufficiently rapid and accurate to determine the iodine content within the range of nanogrammes. (GE)

15650 INVESTIGATION OF ^{90}Sr CONCENTRATION IN FOODSTUFFS AND ITS INTAKE BY POPULATION. Brezikova, D.; Kunz, E. (Inst. of Hygiene and Epidemiology, Prague). Cesk. Hyg.; 18: No. 1, 5-11(Feb 1973). (In Czech).

In 1966 to 1967 the concentration of ^{90}Sr in certain kinds of foodstuff that are the main source of calcium in the diet was studied. The investigation was carried out in selected regions of Czechoslovakia with different hydrometeorologic conditions and aimed at obtaining representative samples of the radionuclide level in the particular foodstuffs. As for milk, the average value for strontium contamination for 1966 amounted to 13.7 pCi/g related to calcium, the analogous values for one liter being 16.0 pCi/l (arithmetic average) and 14.7 pCi/l (weighted average). For 1967 the respective values dropped to 9.6 pCi/g Ca and 11.35 pCi/l (arithmetic average). The weighted average was not determined. For vegetables the following values were found related to calcium for 1966: carrot: 64.8 pCi/g; cabbage: 19.4 pCi/g; onion: 40.1 pCi/g. Values are also listed of the 1966 and the 1967 strontium concentration in milk, flour, and bread in three selected districts. The testing method is believed to be a useful and practical means for the monitoring of ^{90}Sr concentration changes. It is also believed to be sufficiently representative. (INIS)

15651 TRACES OF LONG-LIVED RADIONUCLIDES IN FOOD, THEIR SIGNIFICANCE TO THE ISRAEL POPULATION. Eisenberg, A. (Ministry of Health, Jerusalem); Felge, Y.; Prulov, Y. pp 64-67 of Proceedings of the 6th National Conference of the Israel Health Physics Society. Schlesinger, T. (ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From 6th national conference of the Israel Health Physics Society; Nahal Soreq, Israel (19 Dec 1971).

Routine monitoring of ^{137}Cs and ^{90}Sr levels in the main classes of food consumed in Israel was carried out for a number of years. Calculations have been made of the average population intake of these radioisotopes through food using available statistical data. The scope of the work has been extended by carrying out more detailed analysis to calculate the exposure to specific groups selected on a demographic and economic basis. This will enable the detection of critical groups in the population which may be exposed to high levels of radioactivity in their food as a result of their dietary habits. Models for the prediction of the increased exposure resulting from a significant increase in the contamination level of local food are now available as a result of the work reported here. (INIS)

15652 POLONIUM RADIOACTIVITY IN CERTAIN MIDWATER FISH OF THE EASTERN TEMPORAL PACIFIC. Hoffman, F. L.; Hodge, V. F.; Folsom, T. R. (Scripps Institution of Oceanography, La Jolla, CA). Health Phys.; 26: No. 1, 65-70 (Jan 1974).

Natural radioactive ^{210}Po activities of nine food organisms of tunas were determined. These measurements included individual organ analysis in many instances for making comparisons with recently reported concentrations in the visceral organs of albacore. Of these samples, the highest ^{210}Po activity (61 pCi/g wet) was found on the viscera of a surface-living saury. However, the average concentration in the nine food organisms (2.1 pCi/g wet) was significantly the same as the whole-body values (1.5 pCi/g wet) observed in albacore. (auth)

Radiometric Techniques

Refer also to abstracts 15232, 15315, 15624, 15744, 15745, 15772, 15775, 16098, and 16417.

15653 WELL LOGGING COMPRISING DETECTING UNSTABLE RADIOACTIVE ISOTOPES OF ALUMINUM. Paap, H. J.; Tanner, H. L. (to Texaco Inc.). US Patent 3,781,545. 25 Dec 1973. Filed Date 26 May 1971. 18p.

A radioactivity well logging system is provided for determining the activation reactions $Si^{28}(n,p)Al^{28}$ and $Al^{27}(n,\gamma)Al^{28}$ produced by bombardment of the earth formations with fast neutrons. The activation reaction data are then combined with conventional N-γ log data of the same earth formations to assist in distinguishing dry gas hydrocarbon bearing zones from limestone formations. All data necessary for the gas determination may be obtained in one logging run if a pulse neutron source is used. A continuous neutron source may be used in the gas determination method but may require at least two passes of the logging tool over the same depth earth formations. (Official Gazette)

15654 ATMOSPHERIC TRACE GASES IN THE SOUTHERN HEMISPHERE. Wilkniss, P. E.; Lamontagne, R. A.; Larson, R. E.; Swinnerton, J. W.; Dickson, C. R.; Thompson, T. (Naval Research Lab., Washington, DC). Nature (London) Phys. Sci.; 245: No. 142, 45-47(17 Sep 1973).

Certain inert gases, including Rn and ^{37}Ar, have been suggested as tracers of large scale atmospheric motion and diffusion rates, and air-sea interaction, including evaporation rates in hurricanes, can be deduced from HTO vapor and Rn considerations. In November and December 1972 measurements of a number of trace gases, including Rn, were made in the air over the North and South Pacific and the ice covered Ross Sea, from the US Coast Guard icebreaker Glacier. Results for Rn are shown graphically, expressed as picocuries per cubic meter. North of 5°N Rn values ranged from ~2 to 14 pCi/m^3, whilst in the Southern hemisphere the values ranged around 1± 0.5 pCi over long sections of the cruise track. Very low values of 0.3 pCi were found near the equator and around 70°S. These values must have been upper limits for Rn, since β-radiation from fission products may have contributed to the total measured activity in this concentration range. Applications to environmental investigations are discussed. An interesting observation was that of "radonic storms", or temporary increases of Rn during a limited period of say 24 hr above low maritime values. (UK)

15655 ROCK AND SOIL DISCRIMINATION BY LOW ALTITUDE AIRBORNE GAMMA-RAY SPECTROMETRY IN PAYNE COUNTY, OKLAHOMA. Schwarzer, T. F. (Esso Production Research Co., Houston, TX); Adams, J. A. S. Econ. Geol.; 68: No. 8, 1297-1312 (Dec 1973).

The ability to identify and discriminate rock and soil types from the air using gamma spectrometry was investigated in Payne County, Oklahoma. The data, which were reduced to concentration values for K, U, and Th, were obtained from a helicopter at an average altitude of 75 feet above the ground. The area investigated was underlain by a variety of sedimentary rocks which encompassed a transitional sequence from continental deltaic deposits through marine sediments. Because of the shallow depths sensed aeroradiometrically (about one foot), the data were first related to the pedology of the area considering the regolith independent of underlying bedrock. However, it was soon discovered that in-situ soils could only be distinguished to the extent that their parent lithologies could be discriminated. Concentrations of K, U, and Th determined from the air suggest that the "signatures" of these elements in underlying bedrock are largely preserved in in-situ soils allowing the identification of lithologies and the discrimination of lithologic contacts from the air. Transported soils were generally distinguishable from in situ-soils and hence, common lithologies of the area. A sequence of sedimentary formations was established on the basis of shale content. Quantitative estimates of percent clay were made using thorium contents as an indicator of clay (shale content) and an attempt was made to relate clay content to soil engineering properties. In an effort to find new improved means of aeroradiometric data presentation, a multivariate technique, cluster analysis, was used. This technique merged the K, U, and Th data and produced lithologically significant groupings of rock formations. Such an approach might be used as a step toward generating a single "lithologic" map directly as opposed to the traditional individual element, multi-map technique currently used. The study emphasizes that spectral data converted to concentration units (ppM or %) are superior to qualitative count rates (cps) or total radioactivity for the discrimination and identification of lithologies. Ratioed spectral data in the study area were relatively insensitive to lithologic changes and suggest that anomalies may be enhanced by such a ratioing procedure. (auth)

15656 DETERMINATION OF INSOLUBLE RESIDUE AND CLAY PARTICLES IN DEVON CARBONATE ROCKS OF THE PRIPYAT TROUGH FROM WELL RADIOMETRY MEASUREMENTS. Anpilogov, A. P. (Inst. of Geochemistry and Geophysics, Minsk). Dokl. Akad. Nauk BSSR; 17: No. 10, 952-955 (Oct 1973). (In Russian).

Graphs of insoluble residue vs gamma activity of the subject material were shown to be linear. Curves of natural gamma activity made from well logging and changes in insoluble residue with depth in general agreed well and confirmed the linear dependence. Deviations from linearity were found when the material contained sulfate or chloride. (TTT)

Site Surveys

Refer also to abstracts 15566, 15568, 15593, 15612, and 15784.

15657 (DOCKET-701193-6) CIMARRON PLUTONIUM PRODUCTION PLANT. Environmental Report, Supplement 1. (Kerr-McGee Corp., Oklahoma City, Okla. (USA)). Dec 1973. 296p. Dep. NTIS $17.00.

Additional information is provided on environmental matters in answer to a request from the Director of Licensing. The site, radioactive waster systems, radioactive materials inventory, thermal discharges, environmental effects of plant operation or accidents, surveillance and monitoring systems, and alternatives to the plant are discussed. A biota inventory and seismic analyses are included. (MCG)

15658 (PNE-RB-51-1) RADIOLOGICAL MONITORING PROGRAM, PERIOD COVERING OCTOBER 1, 1971 THRU DECEMBER 31, 1971 FOR CER GEONUCLEAR CORPORATION, PROJECT RIO BLANCO. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA). Dept. of Nuclear Sciences). [nd]. 26p. Dep. NTIS $3.50.

Data are presented on levels of radioactivity in environmental samples collected in the environs of the planned Rio Blanco underground nuclear explosion during the last quarter of 1971. Data are included on β and γ activity in air particulates; the content of fallout ^{144}Ce, ^{106}Ru, and ^{95}Zr in air; the gross α, β, and γ activity and content of ^{89}Sr, ^{90}Sr, and tritium in surface water; the gross β activity and content of ^{89}Sr and ^{90}Sr in milk samples; and the content of ^{89}Sr and ^{90}Sr in vegetation. (CH)

15659 (PNE-RB-51-2) RADIOLOGICAL MONITORING PROGRAM: PERIOD COVERING JANUARY 1, 1972 THRU MARCH 31, 1972. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA). Dept. of Nuclear Sciences). 1972. 17p. Dep. NTIS $3.00.

For CER Geonuclear Corp.

Data are presented on levels of radioactivity in environmental samples collected in the environs of the planned Rio Blanco underground nuclear explosion during the first quarter of 1972. Data are included on β and γ activity in air particulates; the content of fallout ^{141}Ce, ^{103}Ru, and ^{132}Te from the Chinese nuclear test; and the content of tritium in soil samples. (CH)

15660 (PNE-RB-51-3) RADIOLOGICAL MONITORING PROGRAM: PERIOD COVERING APRIL 1, 1972 THRU JUNE 30, 1972. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA). Dept. of Nuclear Sciences). 1972. 22p. Dep. NTIS $3.25.

For CER Geonuclear Corp.

Data are presented on levels of radioactivity in environmental samples collected in the environs of the planned Rio Blanco underground nuclear explosion during April, May, and June 1972. Data are included on β activity in samples of air, surface water, and milk; γ activity of air particulates and soil samples; the content of tritium in soil; and the content of ^{40}K and ^{90}Sr in milk samples. (CH)

15661 (PNE-RB-51-4) RADIOLOGICAL MONITORING PROGRAM, JULY 1, 1972–SEPTEMBER 30, 1972. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA). Dept. of Nuclear Sciences). 1972. 18p. Dep. NTIS $3.00.

For CER Geonuclear Corp., Las Vegas, NV.

Data are presented on levels of radioactivity in environmental samples collected in the environs of the planned Rio Blanco underground nuclear explosion during the third quarter of 1972. Data are included on the β activity and content of fallout ^{144}Ce, ^{106}Ru, and ^{95}Zr in surface air; the β and γ activity in samples of surface water; the β activity and content of ^{40}K in milk samples; and the content of ^{90}Sr in fish. (CH)

15662 (PNE-RB-51-5) RADIOLOGICAL MONITORING PROGRAM, FEBRUARY 15, 1973–MAY 16, 1973. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA)). 1973. 23p. Dep. NTIS $3.25.

For CER Geonuclear Corp., Las Vegas, NV.

Data are presented on the pre-shot radioactivity in environmental samples collected in the vicinity of Project Rio Blanco (Colorado) during February 15 through May 16, 1973. Radioactivity due to fallout and natural background is reported. (CH)

15663 (PNE-WW-32) ENVIRONMENTAL MONITORING REPORT: PERIOD COVERING MAY 1, 1973 THRU JULY 31, 1973. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA)). 1973. 25p. Dep. NTIS $3.25.

For El Paso Natural Gas Co.

Data are presented on the pre-shot radioactivity in environmental samples collected in the vicinity of Project Wagon Wheel (Wyoming) during May, June, and July 1973. Radioactivity due to fallout and natural background is reported. (CH)

15664 (RT/PROT-(73)-10) METEOROLOGICAL MEASUREMENTS IN THE LOWER STRATA AND THEIR INTERPRETATION IN THE STUDY OF ATMOSPHERIC DIFFUSION AT THE BRASIMONE SITE. First Report. Cagnetti, P.; Palmieri, S.; Simonini, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 6 Apr 1973. 70p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.50

Four series of meteorological measurements, one for each season, were carried out during 1972 and 1973 with the aim of characterizing the Brasimone reactor site from the atmospheric diffusion point of view. The data collected during the soundings effected in the summer period are reported. After a relation about the meteorological situation the data on the temperature and wind during the period 16 to 23 July 1972 were correlated to evaluate the local effects on particle diffusion over a short range and to obtain some information about the circulation at the meso-scale level. (auth)

15665 (RT/PROT-(73)-14) METEOROLOGICAL ANNUAL REPORT, 1972. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 3 May 1973. 83p. (In Italian). Dep. NTIS (U. S. Sales Only) $6.25.

The meteorological data for the EUREX plant at Saluggia are presented in tabular and graphic form. A brief description is given of the characteristics of the area and of the general climatological profile. (JSR)

Thermal Effluents

Refer also to abstract 17670.

15666 (COO-2158-10) INVESTIGATION OF THE INFLUENCE OF THERMAL DISCHARGE FROM A LARGE ELECTRIC POWER STATION ON THE TEMPERATURE AND NEAR-SHORE CIRCULATION OF LAKE MICHIGAN. Quarterly Progress Report, 1 October 1973–31 December 1973. Mortimer, C. H.; Sato, G. K. (Wisconsin Univ., Milwaukee (USA). Center for Great Lakes Studies). 1973. Contract AT(11-1)-2158. 4p. Dep. NTIS $4.00.

Progress is reported on studies on nearshore circulation of thermal effluents from the Oak Creek Power Plant, Oak Creek, Wisconsin, in Lake Michigan. Some preliminary data were processed by computer programs to obtain hourly averaged values from ten minute interval values, vector frequency diagrams, and progressive vector diagrams that illustrate the distribution of current meter data according to intervals of speed and direction. (CH)

15667 (INIS-mf-282) THERMAL EFFECTS OF NUCLEAR POWER PLANTS. Antonelli, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Div. Protezione Sanitaria e Controlli). 1972. 26p. INIS.

A survey is made of the biological effects of water temperature increases, as a consequence of the reduced oxygen content in water, and of the increased metabolic rate in living beings. Indeed some phenomena, such as cultural eutrophization and selection of some species against others, foreshadow strong modification in the natural environment. Then the effects induced by these processes are discussed from the cultural, social, and economic standpoints. The second part of the paper considers possible technical solutions (such as cooling towers), which are proposed when the environment is not capable of harmless absorption of the discharge heat. Such solutions are compared from the viewpoint of their technical complexity, economics, and environmental impact. Some proposals for a positive utilization of the discharge heat are eventually reviewed in the light of their applicability to Italy's specific situation. (INIS)

15668 (TID-3918) HEATED EFFLUENTS AND EFFECTS ON AQUATIC LIFE WITH EMPHASIS ON FISHES. A Bibliography. Bulletin No. 9. Raney, E. C.; Menzel, B. W.; Weller, E. C. (Ichthyological Associates, Ithaca, N. Y. (USA)). 1973. 651p. Dep. NTIS $13.60.

A bibliography of more than four thousand references to the literature on the effects of heated effluents on aquatic organisms is presented. A permuted title index and author index are included. (HLW)

15669 PHYSICAL-NUMERICAL MODEL FOR THE DETERMINATION OF THE METEOROLOGICAL INFLUENCES OF COOLING TOWERS ON THE ENVIRONMENT. Ott, W. (Deutscher Wetterdienst-Zentralamt, Offenbach am Main, Ger.). Meteorol. Rundsch.; 26: No. 4, 97-102(1973). (In German).

In spite of the increasing importance of evaporative cooling towers, there are only a few contributions dealing with the meteorological effects of cooling tower effluents. A simple numerical model is developed, using the methods of one-dimensional cumu-

lus-convection and the Gaussian-solutions of the diffusion-equation. (auth)

15670 VULNERABILITY AND SURVIVAL OF YOUNG CONNECTICUT RIVER FISH ENTRAINED AT A NUCLEAR POWER PLANT. Marcy, B. C. Jr. (Essex Marine Lab., CT). J. Fish. Res. Board Can.; 30: No. 8, 1195-1203(1973).

Most of the young fish of nine species that were entrained in the condenser cooling-water system of the Connecticut Yankee nuclear power plant were dead by the time they reached the lower end of the plant's 1.83-km (1.14 mile) long discharge canal. Sampling during June and July, when 95% of the nonscreenable fish were abundant near the plant's intake, showed that approximately 80% of the mortality in the canal was caused by mechanical damage and 20% was attributed to heat shock and prolonged exposure to temperatures elevated above 28 C. There was no measurable mortality due to the injection of sodium hypochlorite into the system as a biocide. The number of nonscreenable living fish entrained at the intake averaged about 4% (range, 1.7-5.8%) of those passing by the plant under conditions of unidirectional net tidal flow. (auth)

Chemical Effluents

Refer also to abstracts 17976 and 18021.

15671 TOXIC TRACE ELEMENTS: PREFERENTIAL CONCENTRATION IN RESPIRABLE PARTICLES. Natusch, D. F. S.; Wallace, J. R.; Evans, C. A. Jr. (Univ. of Illinois, Urbana). Science; 183: No. 4121, 202-204(18 Jan 1974).

The toxic trace elements arsenic, antimony, cadmium, lead, selenium, and thallium were found to be most concentrated in the smallest respirable particles emitted from coal-fired power plants. These elements, or their compounds, are probably volatilized during combustion and preferentially adsorb or condense onto the small particles which can most easily pass through conventional control equipment. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 16397 and 16399.

15672 ELEKTRONNYE METODY YADERNOI FIZIKI. (Electronic Methods in Nuclear Physics). Matalin, L. A.; Chubarov, S. I.; Timokhin, L. A.; Smirnov, V. I.; Nesterenko, V. S. Moscow; Atomizdat (1973). 520p. (In Russian).

The general principles of the construction of electronic equipment and installations used in experimental nuclear physics are examined. Special attention is given to the electrical circuits of different spectrometers and the selection of the characteristics of these circuits with respect to the physics problem. The construction of automatic systems for the collection and processing of data, based on the use of computers, is discussed. (988 references) (tr-auth)

General Detectors and Monitors

Refer also to abstracts 16093, 16400, and 17637.

15673 (AEEW-R-910) SMALL PULSE BREAKDOWN PHENOMENON IN MINERAL INSULATED CABLES. McMinn, K. W. (UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). Nov 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

A pulse breakdown phenomenon in which relatively small transfers of charge take place has been observed on mineral insulated cables used for electrical connections to high temperature neutron detectors. It is demonstrated that the breakdown occurs in small pockets of gas within the insulator, and the mechanism of breakdown is discussed. Some work has also been undertaken to investigate the generation of the breakdown sites and a method of recovering the afflicted cables is given. (auth)

15674 (BNWL-SA-4761) BIOMEDICAL PROBE USING A FIBER OPTIC COUPLED SCINTILLATOR. Swinth, K. L.; Ewins, J. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1973. Contract AT(45-1)-1830. 17p. (CONF-731123-3). Dep. NTIS $3.00.

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, Illinois, USA (25 Nov 1973).

A biomedical scintillation counter similar in size to a fiber-optic gastroscope was fabricated to count low concentrations of internal radioactivity. The probe was built specifically to count the uranium L x rays (average energy 17 keV) emitted in the decay of plutonium located in the tracheobronchial lymph nodes. Plutonium is found in the tracheobronchial lymph nodes due to translocation of inhaled insoluble plutonium compounds. Efforts with the scintillation technique resulted in a probe with higher sensitivity than a previously developed solid-state avalanche diode probe. Although the probe was developed specifically for counting plutonium, it can be readily applied to counting other isotopes with low energy photons such as ^{131}I, ^{125}I, ^{197}Hg, ^{67}Ga, ^{133}Xe, ^{99m}Tc, etc. The physical features and the performance of the fiber optic coupled scintillation counter are described, and the probe is compared with similar solid-state probes. Previous fiber optic probes have been built for dosimetry; however, the present probe is designed for low background, low energy, high sensitivity photon counting. (WHK)

15675 (COS-9) DEVELOPMENT OF A PORTABLE INSTRUMENT FOR THE MEASUREMENT OF NEUTRONS AND GAMMA RAYS EMITTED FROM NUCLEAR FUEL MATERIALS. Tarrant, S. H. W.; Terrey, D. R. (UKAEA Weapons Group, Aldermaston, Atomic Weapons Research Establishment). [nd]. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The principle of measuring plutonium-240 by counting the neutrons from spontaneous fission is well established. In many safeguards applications, the presence of neutrons arising from (α,n) reactions on light element impurities can either be disregarded or roughly corrected for, so that a simple neutron counter can be used. For precise measurements an adequate means for distinguishing between neutrons of different origin is required and circuitry has been evolved to permit this discrimination. Since certain plutonium coupons for the Zebra reactor at AEE Winfrith are under IAEA Safeguards, a fission neutron discriminator and counter appeared desirable. This could be sufficiently compact to be incorporated into the existing Pitman model 292 portable gamma spectrometer, giving a versatile and easily portable instrument with both neutron counting and gamma spectrometric facilities. The development and construction of the prototype instrument which has satisfactorily demonstrated the feasibility of the scheme are described. The neutron detector assembly uses four Type 12EB70 2.5 cm diameter BF_3 tubes, two in each half of a hinged polyethylene block. (WHK)

15676 (EGG-565-120) PRELIMINARY STUDIES OF CHARGE CARRIER TRANSPORT IN MERCURIC IODIDE RADIATION DETECTORS. Llacer, J.; Watt, M. K.; Schieber, M.; Carlston, R.; Schnepple, W. (California Univ., Los Angeles (USA); EG and G, Inc., Goleta, Calif. (USA)). 1973. 11p. (CONF-731112-23). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Mercuric iodide single crystals have been grown by static and dynamic sublimation methods. Characteristics of contacts and detector capacitance have been studied by photon excitation methods. Gamma and x-ray spectrometry has been carried out with completed detectors showing resolutions comparable to the best results published to date. A measurement of hole trapping length has been made from the spectral shapes observed and has been found to be approximately 0.3 mm. Transient waveform analysis with alpha-particle excitation shows hole mobilities of approximately 3 cm^2/V-sec for a highly purified crystal and 0.05 for an expected less pure crystal. Electron mobilities of 120 cm^2/V-sec are observed. An attempt is made to explain the observed transient waveforms in terms of a single dominant trap model, with only partial success. Due to the strongly excitonic character of the material, it is proposed that the unfamiliar observations made regarding transport properties with the HgI_2 detectors studied may be due to exciton dissociation under high electric fields, to long exciton lifetimes and to interactions between excitons and trapping centers in the material. (auth)

15677 (EGG-1183-2299) MONTE CARLO CALCULATION OF THE RESPONSE FUNCTION FOR A 4- BY 4-INCH NaI CRYSTAL SCINTILLATION DETECTOR. O'Dell, A. A. (EG and G, Inc., Goleta, Calif. (USA)). Nov 1972. Contract AT(29-1)-1183. 27p. Dep. NTIS $4.00.

Monte Carlo transport techniques have been utilized to calculate the energy deposition in the 4-inch-dia by 4-inch-long NaI crystal of a scintillation detector. Point isotropic sources with energies of 0.060, 0.662, 1.84, 2.62, and 4.0 MeV were positioned at 100 cm from the crystal on the axis of symmetry. Associated pulse height spectra were then calculated by simulation of the inherent statistical variance by use of a semi-empirical Gaussian broadening. Comparisons are made with similar calculations for an identical bare crystal and with available experimental results. Although the calculated and experimental shapes do not agree ideally over the entire pulse height range, the basic spectral features are in good agreement. Improved experimental measurements are in progress which should resolve the observed discrepancies. The detectors studied are those used in the Aerial Radiological Measurement System (ARMS). (auth)

15678 (IFVE-SEF-73-14) INFLUENCE OF $Ar-CO_2$ GAS-MIXTURE COMPOSITION ON THE CHARACTERISTICS OF THE MULTIWIRE PROPORTIONAL CHAMBER. Glebov, V. Yu.; Zelenskii, A. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 13p. (In Russian). INIS.

The dependence of the characteristics of the multiwire proportional chamber on the relative concentration of the gases in the $Ar-CO_2$ mixture was studied. This available and inexpensive mixture of industrial purity Ar and unpurified CO_2 guarantees prolonged operation of the chamber under large load conditions. It was established that the change of the relative concentrations of the $Ar-CO_2$ mixture substantially changes the range of the operating voltage, but affects only slightly the efficiency of the proportional chamber. The time resolution of the proportional chamber essentially depends on the percent of CO_2 concentration in the mixture. The best time resolution for $Ar-CO_2$ mixtures was obtained at CO_2 concentrations of about 30%. (tr-auth)

15679 (ORO-2843-23) DEVELOPMENT AND APPLICATIONS OF THIN FILM DETECTORS. Progress Report, January 1–December 31, 1973. Muga, M. L. (Florida Univ., Gainesville (USA)). [nd]. Contract AT(40-1)-2843. 107p. Dep. NTIS $7.50.

Topics discussed include: improved model of thin film luminescence response to transiting heavy ions; response of thin film scintillator detector to high energy argon and krypton ions; luminescence response of thin plastic scintillator detectors to fission fragments from proton induced fission of ^{232}Th, ^{235}U, and ^{238}U;

fragment nuclear charge structure in the thermal-neutron-induced fission of ^{235}U; specific luminescence studies in plastic scintillators; and applications of thin film scintillator detectors to fission investigations. (TFD)

15680 (SLA-73-979) MOD 3 FAMILY OF PRODUCTION COMPTON DIODES. Conrad, M. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 16p. Dep. NTIS $3.00.

Compton diodes (CDs) have become increasingly popular as gamma sensors to trigger oscilloscopes on nuclear tests. Mechanical and electrical details of a family of four types of production CDs which are economical to produce and should fill many needs for this sensor are given. At Sandia these are on-the-shelf items. (auth)

15681 (UILU-73-2562) STUDIES OF SILICON EXTRINSIC DETECTORS. Scientific Report No. 1. Sah, C. T. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). 28 Nov 1973. 36p. (AFCRL-TR-73-737). NTIS.

Theoretical analyses of the effects of ion position correlation on the electron mobility in n-type silicon are compared with experiments. Steady-state and transient extrinsic photoconductivity were analyzed including the presence of recombination centers. Theoretical analyses were made of the photoionization cross-section of impurity for Coulomb and spherical square wells and compared with experimental data of shallow acceptors in silicon. (GRA)

15682 ENERGY LOSSES AND RANGES OF LOW ENERGY HEAVY CHARGED PARTICLES IN PLASTIC NUCLEAR TRACK DETECTORS. Endo, K. (National Lab. for High Energy Physics, Oho, Japan); Doke, T. Jap. J. Appl. Phys.; 12: No. 9, 1403-1409 (Sep 1973).

A method for the calculation of the energy losses of heavy charged particles in a low energy region (<1 MeV/nucleon) for the plastic nuclear track detectors is described. The method is based on the fundamental relation $(dE/dx)_{ion} = (Z_{eff}/\gamma_p)^2(dE/dx)_{proton}$ (Z_{eff} and γ_p are the effective charges of heavy ions and protons, respectively). The stopping power of a given plastic detector for the proton was obtained from the atomic stopping powers of the individual constituent elements for the proton, which are derived from the existing data for other organic compounds in solid state, assuming the Bragg's additivity rule. Then, the energy loss rates of heavy ions in the plastic detectors were calculated from the above relation, using the formulas for the effective charges. The range-energy relations, obtained by this method, for fission fragments in polycarbonate resin and cellulose triacetate were in good agreement with the experimental results. (auth)

15683 RESPONSES OF SOME NaI(Tl) CRYSTALS AT HIGHER SOURCE–CRYSTAL DISTANCES AND THE CORRESPONDING BACKSCATTER PEAKS. Swarup, J. (Bhabha Atomic Research Centre, Bombay). Indian J. Pure Appl. Phys.; 11: No. 5, 331-333 (May 1973).

The responses of NaI(Tl) crystals of various dimensions were studied in the photon energy range 0.28 to 2.75 MeV, for distances from 20 to 250 cm between source and crystal. It was found that for the same photopeak counts, the backscatter peak counts were appreciably higher for the greater distances in all the crystals. It was found that the backscatter peak was made up of two components: one was due to those photons which enter the crystal directly from the source and are backscattered within the detector assembly, and the other was due to those photons which are first backscattered by the surroundings of the detector assembly (hence independent of source-crystal distance) and then enter the crystal. At higher source-detector distances, the latter component is much more than the former one, and hence the higher backscatter counts. The investigation is of interest in studies involving large distances between the source and detector. Photopeak-to-total ratios of the crystals used are also reported. (auth)

15684 USE OF PHOTOEFFECTS IN SYSTEMS WITH A TRANSITIONAL DEPLETION LAYER IN IONIZING RADIATION DETECTORS. Gorban, A. P.; Litovchenko, V. G.; Serba, A. A.; Moskal, D. N. (Inst. of Semiconductors, Kiev). Poluprov. Tekh. Mikroelektron.; No. 11, 27-34(1973). (In Russian).

The amplitude characteristics and kinetics of conductivity relaxation, effective differential capacity, and photovoltaic effect in MIS structures with a transitional depletion layer exposed to ionizing radiation are analyzed theoretically. The results of experiments on the effect of strongly absorbed light and monochromatic 1.3 - MeV gamma radiation on the kinetic and amplitude characteristics of these effects are presented. These results indicate possibilities of using MIS structures with a transitional depletion layer as threshold detectors and dosimeters of ionizing radiation. (tr-auth)

15685 ALPHA-PARTICLE REGISTRATION CHARACTERISTICS IN DAICEL CELLULOSE NITRATE SSNTD. Khan, H. A.; Durrani, S. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 114: No. 2, 291-295(1974).

The characteristics of the revelation of α particles of three different energies (≈ 4.5, 5.5 and 6.1 MeV) incident on "Daicel" cellulose nitrate have been studied as a function of the etching time as well as of the angle of incidence and the residual energy. It is found that the lower the initial or the residual energy of the α particles, the earlier in etching time are they revealed, and that obliquely incident particles are revealed later than the normally incident ones. A simple model based on variations in the specific ionization of the particles is proposed to account for these and related observations. (auth)

15686 TIME RESPONSE OF PLASTIC SCINTILLATORS. Lyons, P. B. (Los Alamos Scientific Lab., NM); Stevens, J. Nucl. Instrum. Methods; 114: No. 2, 313-320(1974).

Time-response characteristics of eight commercial plastic scintillators have been studied. Samples were excited by 50 ps electron or bremsstrahlung pulses. Sampling techniques were used to record the signal from a fast vacuum photodiode. Effects of surface preparation on time response were studied. The observed fwhm (in ns) for the three fastest plastics was 1.5, 2.0, and 2.3 for NE111, Pilot U, and KL236 respectively. The effect of various optical filters was studied for NE111. With suitable filtration, a minimum fwhm of 1.15 ns was observed for NE111. Time response of NE102 samples was studied as a function of thickness. For thin samples, improvement in time response was observed. (auth)

15687 RESOLVING ABILITIES OF GERMANIUM RADIATION DETECTORS. Danengirsh, S. G.; Pakhomov, E. E.; Strokan, N. B.; Subashieva, V. P.; Fedorova, S. F. Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 5, 18-22(1973). (In Russian).

Factors which reduce the energy resolution of germanium radiation detectors fabricated by γ-compensation were investigated. It was found that the resolution depends on the life time of the holes after the compensation process and it can be improved in an electric field of more than 1.3 kV/cm (auth)

15688 CONSTRUCTION AND PERFORMANCE OF A LARGE LIQUID SCINTILLATION COUNTER. Dakin, J. T. (Stanford Univ., CA). Nucl. Instrum. Methods; 114: No. 2, 393-395(1974).

A liquid scintillation counter with an active volume of 3.05 m × 0.20 m × 0.20 m was constructed with a simple, inexpensive, and rugged design. Some properties of this counter are reported. (auth)

15689 FLUORESCENCE SELF-ABSORPTION EFFECT AND TIME RESOLUTION IN SCINTILLATOR COUNTERS. Sipp, B.; Miehe, J. A. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods; 114: No. 2, 255-262(1974).

Conclusive evidence that the variation of the prompt resolution curves with the size of a fast liquid scintillator results to a high degree from the self-absorption effect on the fluorescence characteristics of the scintillator is presented. This was demonstrated by measurements of the equivalent illumination function (i.e., radioluminescence decay curve); the analysis of the experimental results shows an important increase of the fwhm of the scintillation pulse shape with the dimensions of the scintillator. The experimental data are discussed in terms of optical reflections on the surface of the scintillator and of fluorescence self-absorption: a prevailing influence of the latter must be postulated. A time resolution of 176 ps for ^{22}Na has been obtained with a fast liquid scintillator of cylindrical shape with 2 cm diameter and 1 cm height. (auth)

15690 EUROPIUM-DOPED, CALCIUM-FLUORIDE SCINTILLATOR SYSTEM FOR LOW-LEVEL TRITIUM DETECTION. Colmenares, C.; Shapiro, E. G.; Barry, P. E.; Prevo, C. T. (Univ. of California, Livermore). Nucl. Instrum. Methods; 114: No. 2, 277-289(1974).

An in-line detector and electronic system for low-level tritium detection have been built and tested. Tritium betas are detected with a europium-doped calcium-fluoride CaF_2 (Eu) scintillator–photomultiplier combination. An inexpensive, fully integrated circuit, amplifying pulse shape analyzer, was designed and built for detecting low-level signals in the presence of phototube noise and cosmic ray overloads. The amplifying pulse shape analyzer performs signal post-amplification and -shaping, pulse shape discrimination, and single channel energy analysis. The system is ideally suited for computer monitoring and controlling of tritium-contaminated gas streams. A detailed description is presented of the detector and accessory electronics as well as the system calibration using tritiated gas standards for a range of tritium concentration from 0.35 nCi/cm^3 (STP) to

0.68 $\mu Ci/cm^3$ (STP). The minimum detectable concentration was calculated to be 48 pCi/cm^3 (STP). (auth)

15691 BAKEABLE IONIZATION CHAMBER FOR LOW-LEVEL TRITIUM COUNTING. Colmenares, C. A. (Univ. of California, Livermore). Nucl. Instrum. Methods; 114: No. 2, 269-275(1974).

In order to minimize background and facilitate decontamination, a cylindrical ionization chamber using ultrahigh-vacuum metallic seals was constructed. Sapphire and pure alumina insulators isolated the collector electrode from the chamber. The chamber and inlet lines are bakeable to 450°C and withstand pressures up to 3 atm. The unshielded background of a new chamber was 2fA. The operating voltage plateau of the chamber was determined at 20 and 764 torr. Output current vs total tritium content was calibrated using tritiated methane and a tritium-argon mixture, both by increasing the pressure of a constant-concentration standard and by diluting the standard gas mixture at constant pressure. Theoretical calculations of efficiency of beta-energy absorption in spherical vessels filled with several gases are presented, as well as experimentally determined chamber efficiencies for methane and argon. (auth)

15692 IMPROVEMENTS IN THE MOUNTINGS FOR RADIATION DETECTING DEVICES. Cocks, F. H.; Bates, H. E. (to Tyco Labs., Inc.). US Patent 3,784,860. 8 Jan 1974. Filed date 29 Sep 1971. 10p.

Improved gas discharge radiation detecting devices have long life spans under severe environmental conditions and under high vibration. A first, tubular electrode surrounds a second, elongated wire electrode with a hermetically sealed gas ionization chamber between. A pair of electrode mounting methods mount and tension the wire electrode through friction joints to provide sufficient tension to prevent electrical failure under severe vibration conditions. It has been found that electrical failure of such devices can be caused by vibration conditions which damage a protective surface oxide of the wire electrode and that proper mounting can eliminate such damage thereby greatly prolonging useful life. (Official Gazette)

15693 SCINTILLATION CAMERA WITH IMPROVED RESOLUTION. Jaszczak, R. J. (to G. D. Searle and Co.). US Patent 3,784,821. 8 Jan 1974. Filed date 22 Nov 1971. 12p.

An Anger-type scintillation camera system fitted with a gamma ray filter between the object under study and the detector and a signal funneling type of output signal filter, in mechanical or electrical form, associated with an image recording film, is described. The gamma ray filter and signal funneling type of output signal filter scan in synchronism so that the total radioactivity distribution in the object is documented on the film with improved resolution. (Official Gazette)

15694 SCINTILLATION CAMERA WITH LIGHT DIFFUSION SYSTEM. Martone, R. J.; Goldman, S. C.; Heaton, C. C. (to Picker Corp.). US Patent 3,784,819. 8 Jan 1974. Filed date 5 Mar 1971. 12p.

A scintillation camera of the multiple phototube type is described. A thin light pipe and masks are employed to diffuse the light so that the camera operates on a principle of light diffusion rather than phototube "viewing" as described in the prior art. (Official Gazette)

15695 TOMOGRAPHIC SCANNING PROCESS. Miraldi, F. D. (to Case Western Reserve Univ.). US Patent 3,784,820. 8 Jan 1974. Filed date 25 Jun 1971. 12p.

A radioisotope device having a collimator delimits radiation from a source. A scintillation crystal having a rectangular cross-section and a generally elongated shape receives radiation after it passes through the collimator and changes it to visible light at each point by a process known as scintillation. Photomultiplier tubes at each end of the scintillation crystal convert the light to electrical pulses. The amplitudes of electrical pulses are converted to logarithms of the amplitudes and summed. A pulse height selector chooses only the sums of those logarithms desired for observation. The logarithms of the amplitudes are also subtracted to find the location of the scintillation in the scintillation crystal. Means are also provided for moving the source of radiation relative to the collimator. A recording means stores information concerning the relative positions of the source and the collimator during the time radiation is received. Information from a plurality of scans allows a determination of a pattern of the radiation at different depths and areas within the source. It is also possible to use a plurality of collimators and scintillation crystals and a single scan to determine radiation patterns at multiple depths within the source. (Official Gazette)

15696 SCINTILLATION SCANNER WITH REMOTE CONTROL APERTURE. Stoeckel, A. L.; Mog, W. F.; Brunnett, C. J. (to Picker Corp.). US Patent 3,784,818. 8 Jan 1974. Filed date 3 Jun 1971. 8p.

A scintillation scanner having a visual image producing means coupled to the boom which supports the scintillation detector is described. The image producing means includes a light source for producing a beam of light along a path. An adjustable aperture controls the size of the image produced. (Official Gazette)

15697 CHARGE ACCUMULATION GAMMA RADIATION DETECTOR. Frederickson, A. R.; Morris, A. D. US Patent 3,780,304. 18 Dec 1973. Filed date 28 Jan 1972. 6p.

A gamma ray detector is described which utilizes the charge accumulation at interfaces effect to measure γ-ray intensities. The detector includes a multiplicity of electrically conductive plates mounted in a vacuum chamber. All the plates are substantially parallel to each other. The gamma beam passes successively through all the plates. An electrical current flowing between the inner plates is a measure of the γ-beam intensity. (Official Gazette)

15698 RADIATION DETECTOR. Linner, L. R. (to Honeywell Inc.). US Patent 3,781,563. 25 Dec 1973. Filed date 29 Jan 1973. 8p.

A radiation detector employing two internal ionization-type radiation sensors in a circuit such that one sensor aids the other in detection of radiation while each limits the effects of a failure of the other sensor is described. (Official Gazette)

15699 RADIOGRAPHIC DISPLAY SYSTEM WITH CASSETTE LOCK. Carugati, V.; Colombo, S.; Ferramola, G.; Ferrari, S. (to Raytheon Co.). US Patent 3,781,557. 25 Dec 1973. Filed date 17 Aug 1972. 20p.

A nuclear imaging device comprising a plurality of scanning heads spaced apart in a predetermined configuration with the aid of a support member that permits the individual scanning heads to scan in parallel, antiparallel, and tomographic modes is described. The support member which is driven in both X and Y directions is mechanically connected with the stylus of a graphical X-Y plotter via a backlash linkage. Displays are provided wherein the color of the ink dot on printed paper or the intensity of the light projected on photographic film is related to the nuclear particle count in a preselectable manner. (Official Gazette)

15700 ON-LINE MEASUREMENT OF LIFETIMES IN BEAMS OF HEAVY IONS IN THE MICROSECOND RANGE. Albouy, G.; David, J. C.; Lagrange, J. M.; Pautrat, M.; Roulet, C.; Sergolle, H.; Vanhorenbeeck, J. (Institut de Physique Nucleaire, Orsay, France). Nucl. Instrum. Methods; 113: No. 4, 509-525(1973). (In French).

Life-time measurements were carried out by using time to amplitude conversion methods, the information being classified in a two- or three-dimensional spectrum by means of an on-line IBM 360-50 computer. In the first case, the zero time corresponds to the compound nucleus formation and is defined by a fast coincidence between a prompt γ-ray and the beam pulse detected by a thin plastic foil. In this way, the time distributions of all the γ-rays associated with a given reaction are simultaneously measured and can be extracted from the resulting 1024 (E_γ) × 256 (time) channels spectrum. The random coincidence peaks shown by all the curves with the same repetition rate as that of the cyclotron frequency (150 to 200 ns) can be eliminated by computing the difference between the contributions of a γ-ray and of the continuous background. However, as it is rather difficult to resolve the components of a complex decay curve, when several half-lives of intermediate levels interfere, we turned to a three-dimensional analysis in order to estimate these components. The pulse starting the TAC is due to the same type of coincidence as before but the γ-rays taken into account are now delayed relative to the compound nucleus formation. The size of this delayed γ spectrum is limited by the computer memory and only eight energy regions can be selected (four peaks and the backgrounds nearby, for example). By treating the 8 (E_{γ_2}) × 1024 (E_{γ_1}) × 256 (time) channels spectrum obtained, we can derive the decay curves of all the γ-rays with respect to each of the delayed γ transitions. (auth)

15701 APPARATUS WITH FIXED PRECIPITATION ELECTRODES FOR MEASURING THE CONCENTRATION OF RADIOACTIVE CHARGED PARTICLES ON A HIGH BACKGROUND ACTIVITY. Teodosic, V. M. Danish Patent 127,568. 26 Nov 1973. Filed date 1 Dec 1967. 8p. (In Danish).

A description is given of an apparatus for measurement of radioactive isotopes that, after decay, occur as radioactive ions in the presence of radiation from other radioactive isotopes or some other kind of background radiation. The ionized decay products are collected electrostatically on a fixed precipitation electrode, and the radioactivity from this and from the surroundings is registered by a radiation detector placed at the precipitation electrode. The apparatus can modulate the electrostatic field occurring at the precipitation electrode. The radiation de-

tector is connected with equipment that generates a pure variation voltage in agreement with the recording of the detector and dependent upon the field modulation. The equipment further correlates these voltages by multiplication and by deduction of the mean value of the multiplication result. (DE)

15702 DEVICE FOR MEASURING ACTIVITY CONCENTRATION IN PRIMARY CIRCULATION SYSTEMS OF NUCLEAR REACTORS. Neeb, K. H.; Neidl, H.; Stockert, H. (to Siemens Aktiegesellschaft). US Patent 3,782,268. 1 Jan 1974. Priority Date 30 Jul 1970, F. R. Germany. 6p.

A device for measuring the activity concentration of radioactive fission and corrosive products in coolant primary circulation systems of nuclear reactor plants consisting of a shunt to the primary circulation stem is described. The shunt has a closed pipe system comprising stop valves, pressure reducing valve means, exhaust gas container means and filter means. A displaceable high-resolution gamma detector in operative proximity with the closed pipe system measures the contents of the filter means at different points of the pipe system. (Official Gazette)

15703 METHOD AND DEVICE FOR THE DETECTION OF FISSION PRODUCTS. Kostic, S.; Le Meur, R. (to Commissariat A l'Energie Atomique). US Patent 3,784,823. 8 Jan 1974. Priority Date 22 Jan 1971, France. 6p.

The method consists in carrying out the electrical collection of fission products on both sides of very thin metallized discs of polyester insulating material which are placed at the center of a spherical chamber and in measuring the radioactivity with a set of two electron detectors mounted to detect activity of the discs in all directions. The device for carrying out the method comprises a magazine constituted by a rotary circular ring provided with spaced openings each intended to accommodate a disc, a spherical ion-collection chamber, two parallel semiconductor detectors and a unit for conveying each disc from the magazine into an opening formed in a transfer plate. The disc is transferred by the plate to an ion-collection chamber, then passed between the two detectors in order to measure the activity and energy spectrum of the beta radiation of the collected ions then returned to the magazine. (Official Gazette)

15704 SOLID-STATE SAMSON SURVEY METER (OCT 1968) (ENGINEERING MATERIALS). (Goodyear Atomic Corp., Piketon, Ohio (USA)). (CAPE-2381).

22 drawings.

A Samson Survey Meter (Model 2582, manufactured for Union Carbide Corp.— Nuclear Division by Nuclear Instrument and Chemical Corp.), used for measuring alpha, beta, and gamma radiation, has been converted from a three miniature vacuum tube amplifier, with its multiplicity of battery circuits and large circuit impedances, to a solid-state amplifier resulting in a considerable reduction in maintenance and increased stability compared to the original model. Argon and xenon probes with which this meter also can be used also have been provided with transitorized components. This modified meter, with or without probes, is used routinely in uranium processing facilities, including gaseous diffusion plant applications, to survey plant and equipment for uranium accumulation. The feedback resistor, ionization chamber, and meter circuit are retained without change and the readout characteristics have not been altered. Increased stability is achieved through the use of one common battery with soldered connections throughout and stabilized voltages for the amplifiers, by isolation of the high-impedance input and the feedback resistor in a sealed compartment, and by providing the gate of the Mos-Fet transistor with a negative bias when in the standby condition to prevent long-term initial drift. Cost of the modification is estimated at $200 for material plus five man-days of electronic technician time. Equivalent commercial units are not available. (auth)

15705 DUAL-RANGE ALPHA COUNTER (28 JUL 1971) (ENGINEERING MATERIALS). (Dow Chemical Co., Denver, Colo. (USA). Rocky Flats Div.). (CAPE-2380).

19 drawings.

15706 DISPLAY CONTROLLER FOR THE INTERACTIVE ANALYSIS OF SCINTIGRAMS WITH A PDP-8 COMPUTER. Ebenritter, W.; Hoehne, K. H. (DESY, Hamburg). Kerntechnik; 15: No. 11, 499-502(Nov 1973). (In German and English).

A display controller suitable for the presentation of gray-tone pictures as scintigrams on a CRT for interactive processing is described. It allows the production of a flicker-free image consisting of a matrix of 64 × 64 elements with 16 gray levels. A light pen and an additional storage CRT are supported. (GE)

15707 BETA-EMITTING NUCLIDE ASSAY USING CHERENKOV RADIATION. Oldham, G.; Ware, A. R.; Waterman, G. J. (Loughborough Univ. of Tech., Eng.). J. Inst. Nucl. Eng.; 14: No. 5, 148-151(Sep 1973).

The increasing use and availability of liquid scintillation spectrometers has also meant an increasing availability of apparatus suitable for the measurement of Cherenkov radiation. Some of the parameters that must be taken into account when carrying out Cherenkov counting procedures are discussed; these include the influence of the refractive index of the counting medium, and its density; also geometrical and optical effects, together with the effects of quenching. Methods for eliminating or correcting for quenching are described in detail. It is concluded that Cherenkov counting offers a very useful alternative to the more widely used techniques of liquid, gel, and emulsion counting of radioisotopes. It is probably most suited to the measurement of β emitters with principal energies >1 MeV; for a given medium, counting efficiency decreases with decreasing energy. The main advantages are ease of sample preparation and the absence of chemical quenching. Color quenching occurs, but may be corrected by the standard methods employed in scintillation counting. The presence of a Cherenkov threshold means that mixtures of isotopes may often be assayed by a change in medium, or by using Cherenkov counting in conjunction with scintillation counting. (UK)

15708 NUCLEAR DATA FOR NEUTRON METROLOGY. Zijp, W. L. (Reactor Centrum Nederland, Petten). pp 271-293 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

For many irradiation experiments, knowledge of the neutron field characteristics, such as the neutron spectrum and the flux density distribution, is needed. For the determination of the fluence and the spectrum of neutrons incident on irradiation samples, activation and fission detectors are often applied. This well-known method can yield reliable results when the reaction cross-sections and the decay schemes for the product nuclides are well-known, and absolute activities are determined with good precision. Some topics in this field are discussed, and some recommended data are presented, based on the work performed within the framework of the Euratom Working Group on Reactor Dosimetry. Some questionable points for future investigations or measurements of nuclear data for reactions of interest are also mentioned. (auth)

15709 ELECTROMAGNETIC AND CORPUSCULAR RADIATION DETECTORS BASED ON THE p-Cu_2Se-n-CdSe JUNCTION. Komashchenko, V. N.; Malyuk, N. F.; Fedorus, G. A.; Fursenko, V. D.; Khoma, V. M. (Inst. of Semiconductors, Kiev). Poluprov. Tekh. Mikroelektron.; No. 13, 33-35(1973). (In Russian).

p-n heterojunctions of Cu_2Se-CdSe on a base of polycrystalline CdSe films, sensitive to a wide interval of wave lengths (200 to 700 nm) and to electron beams of medium energy (5 to 40 keV) were developed. New types of instruments using these heterojunctions were proposed and investigated. (tr-auth)

15710 USE OF THE p-Si-SiO_2 SYSTEM WITH SURFACE INDUCTIVE CHANNELS AS A NUCLEAR RADIATION DETECTOR. Barabash, L. I.; Gorban, A. P.; Litovchenko, V. G.; Litovchenko, P. G.; Chala, S. V. (Inst. of Nuclear Research, Kiev). Poluprov. Tekh. Mikroelektron.; No. 13, 82-85(1973). (In Russian).

The use of a dielectric-semiconductor structure, prepared on the base of high-ohm ceramic of the p-type, was proposed for the detection of nuclear radiation. p-Si with surface inductive channels developed on the basis of the p-Si-SiO_2 system was used in the detector. The study, made on the ^{242}Cm α source with energy of 5.8 MeV, showed that semiconductor detectors of this type have an energy resolution of the order of 1.5% and sufficiently high stability with time. (tr-auth)

15711 POSITION-SENSITIVE DETECTORS WITH A P-TYPE SILICON BASIS. Voevoda, G. P.; Kibkalo, T. I.; Kurilo, P. M.; Litovchenko, P. G. (Inst. of Nuclear Research, Kiev). Poluprov. Tekh. Mikroelektron.; No. 12, 75-79(1973). (In Russian).

A one-dimensional position-sensitive detector with a length of 55 mm and a sensitive thickness of 2 to 3 mm was prepared with a base of lithium-compensated high-ohm p-type Si. Pd and Ni-chrome on a thin layer of Au was used as a position film. The position resolution of such detectors at room temperature is 0.3 mm with an energy resolution of the order of 1.6%. Reduction of the temperature to 77°K leads to improvement of the energy and position resolution (up to 1.3% and 0.2 mm, respectively). (tr-auth)

15712 REGISTRATSIYA IONIZIRUYUSHCHIKH IZLUCHENII. (Registration of Ionizing Radiation). Levin, V. E.; Kham'yanov, L. P. Moscow; Atomizdat (1973). 256p. (In Russian).

The basic processes in the interaction of radiation with matter and the methods for the registration of radiation are reported. The construction and electrical wiring diagrams of detectors are described. Methods for the mathematical processing of the measurement results are discussed. (tr-auth)

15713 HIGHLY EFFECTIVE SILICON SURFACE-BARRIER DETECTORS FOR THE REGISTRATION OF SOFT ELECTRONS. Asimov, S. A.; Akhmerov, E. E.; Muminov, R. A.; Shchebiot, U. V. (Physical-Technical Inst., Tashkent, USSR). Dokl. Akad. Nauk Uzb. SSR; No. 6, 25-27(1973). (In Russian).

Surface-barrier detectors with an n-type low-impedance silicon base were produced. The volt-ampere and volt-noise characteristics of these detectors with deep p-n junctions at the ends and surface barriers in the middle were measured. (JSR)

15714 CONSTRUCTION AND PHYSICAL PARAMETERS OF MULTISCAN WHOLE-BODY SCANNER. Silar, J.; Smidova, M.; Vacek, J. (Karlova Univ., Prague). Cas. Lek. Cesk.; 112: No. 16, 453-461(15 Apr 1973). (In Czech).

The construction of a commercial whole-body scanner which permits scanning in the form of a photographic picture, and the distribution in the human body of the activity of gamma emitters having an energy of up to 1.3 MeV, at relatively short intervals are described. The results are presented of the measurement of physical parameters affecting the scanning possibilities of a Model No. 602 Multiscan, produced by Cyclotron Corporation. The resulting radiometric parameters are listed. The results of measurement show that the device can be used in the whole-body scanning of the distribution of the activity of gamma emitters applied in routine procedures, such as 100 μCi of ^{85}Sr, with a position resolution of 25 to 50 mm in a tissue layer in a height of up to 100 mm above the Multiscan table. (INIS)

15715 HAND AND FOOT MONITOR, MODEL MOV-6 (29 Nov 1973) (ENGINEERING MATERIALS). (Argonne National Lab., Ill. (USA)). (CAPE-2382).

60 drawings.

The Hand and Foot Monitor is intended for the detection of radiation contamination on the hands and/or feet of personnel working in an area of possible contamination. The units are about 4½ feet high by 2 feet square at the base, and permit the simultaneous positioning of hands and feet near four separate detectors. The current pulses from the four detectors, which are wide-area gas-flow proportional counters, are fed through charge-sensitive preamplifiers, and then to level-sensitive discriminators, which separate the α pulses from those resulting from β or γ interactions. The four $\beta\gamma$ signals feed four up/down counters, and background compensation is accomplished by counting down during periodic background intervals, and counting up during a monitoring interval triggered by a subject on the monitor. The four α signals are fed to up-counters without the use of background compensation. The automatic up-dating of the background count is accomplished by the use of a clock and suitable memories and sequencing circuits. The nominal background counting interval is 32 seconds, and the monitoring interval is 4 seconds, though both intervals may be changed over limited ranges. Hidden digital switches permit adjustment of the four α and four $\beta\gamma$ count levels which trigger a warning. A visual display indicates an OK or a HOT signal at the end of the four-second monitoring period. If a HOT signal is displayed, the involved limbs are identified. (auth)

Radiation Dosimeters

Refer also to abstract 16454.

15716 (AERE-R-7485) NUCLEAR ACCIDENT DOSIMETRY. Part I. General Principles. Delafield, H. J.; Dennis, J. A.; Gibson, J. A. B. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1973. 40p. Dep. NTIS (U.S. Sales Only) $4.00. UK £1.00.

The objectives and general principles underlying nuclear accident dosimetry are described. Dose concepts applicable to criticality dosimetry are defined, followed by a description of the neutron and gamma-ray components of dose to the body. The relative magnitude of these components is shown to vary markedly with the type of critical assembly. The use of the radioactivity induced by neutrons in both indium foils and the human body, as exposure indicators, is discussed. Methods of deriving the gamma-ray and neutron dose to the body are then reviewed. Finally, the system of nuclear accident dosimetry adopted at Harwell is described; this includes the U.K.A.E.A. personnel criticality dosimeter, installed neptunium (^{237}Np) dosimeter and an experimental threshold detector system. The principles of the dose assessment procedure for the personnel criticality dosimeter are outlined, and its performance given by various methods of interpretation for a variety of neutron spectra. Detailed procedures for making dose assessments are given in Part II (AERE-R 7486). Methods of interpretation and additional data are provided in Part III (AERE-R 7487). (auth)

15717 (AERE-R-7486) NUCLEAR ACCIDENT DOSIMETRY. Part II. Dose Assessment Procedure. Delafield, H. J.; Dennis, J. A.; Gibson, J. A. B. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1973. 46p. Dep. NTIS (U.S. Sales Only) $4.50. UK £1.00.

Detailed operational instructions on methods of dose assessment for the U.K.A.E.A. personnel criticality dosimeter and the installed ^{237}Np dosimeter are presented. Methods of measuring induced radioactivity in the body and clothing of exposed personnel are also included. These techniques are based upon the general principles which have been described in Part I of the manual (AERE-R 7485). The general procedure is (i) monitor exposed personnel, (ii) count components of irradiated personnel dosimeters and installed dosimeters, and measure film dosimeters, (iii) measure radioactivity of blood, hair and clothing of exposed personnel as necessary, (iv) derive the neutron recoil and gamma-ray components of dose. The dose assessments provided by the procedures given need to be interpreted. Methods of doing this will be discussed in Part III of the manual (AERE-R 7487). (auth)

15718 ALPHA PARTICLE DOSIMETER. Alter, H. W.; Lovett, D. B. (to General Electric Co.). US Patent 3,783,292. 1 Jan 1974. Filed date 16 Jul 1971. 6p.

A dosimeter for recording alpha particles using track-registration material is described. The dosimeter consists of a housing and an insert means holding the track-registration material. The dosimeter can be secured to a hat worn by a person working in an environment to be monitored, such as a uranium mine, which may contain quantities of radon gas and radon daughter products. The insert means is easily secured to and removed from the housing. The dosimeter is exceptionally small, light-weight and effective. The combined housing and insert means provides shielding for the film against unwanted radiation from deposited alpha-emitting particles and protects the film from physical contamination. (Official Gazette)

15719 MESON DOSIMETRY FOR THE NATURAL ENVIRONMENT. Gold, R. (Joint Center for Graduate Study, Richland, WA). Radiat. Res.; 56: No. 3, 413-427(Dec 1973).

Separation of the most significant components of the environmental radiation field is now possible through the development of a new method of environmental meson dosimetry. Since this method allows absolute and simultaneous measurement of both gamma and meson dose, it offers particularly cogent advantages for environmental applications. Spherical scintillators, liquid or plastic, are used with integral count rate techniques to provide meson dose with an accuracy of approximately 4%. Even near sea level, where the meson flux is less than 1% of the gamma flux, the environmental meson dose rate can be as high as 40 to 60% of the environmental gamma dose rate. (auth)

15720 RAD CONVERSION FACTOR FOR IONIZATION CHAMBER FOR HIGH-ENERGY X-RAYS AND ELECTRONS. Antoku, S.; Sunayashiki, T.; Takeshita, K. (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 8, 683-688(Aug 1973). (In Japanese).

Conversion factors from roentgens to rads for Ionex, JAPM substandard and Radocon 555 dosimeters for high-energy x rays and electrons were experimentally determined using a Fricke dosimeter. The conversion factors obtained for ^{60}Co γ rays and high-energy x rays agreed within 1% with the values cited in "A Practical Code for Dosimetry of 2 to 35 MV x rays and cobalt-60 gamma-ray beams in Radiotherapy in Japan," which were calculated by Greene and Massey. The values for high-energy electrons were slightly lower than those described in ICRU Report 21, but the differences were well within variation of experimental errors. The factors by depth in water also agreed with those in the ICRU Report for 20 to 30 MeV electrons, assuming that the effective center of the chamber was located one half of the cavity radius in front of the center of the cavity. (auth)

15721 RADIATION DETECTION INSTRUMENTS FOR X-RAY FACILITIES. Pychlau, P. J. Arbeitsschutz (Cologne); No. 4, 179-182(1973). (In German).

In the x-ray ordinance of the FRG, doses and dose rates are given relating to the licensing of x-ray facilities. The instruments required to measure these data, such as dosimeters and other similar devices, are described according to their various functions. The types of these devices as well as the name of the company from which they can be obtained are given. (GE)

15722 PERSONAL MONITORING USING THERMOLUMINESCENCE DOSIMETER. I. Characteristics of Thermoluminescence Dosimeter. Matsuda, H.; Furukawa, S.; Kaminishi, T.; Koshino, M. (Government Industrial Research Inst., Nagoya, Japan). Hoken Butsuri; 8: No. 3, 137-143(Sep'1973). (In Japanese).

In order to use a thermoluminescence dosimeter for personal monitoring, some practical characteristics such as reproduci-

bility, deviation among elements, and degradation of sensitivity were examined during the repeated usage over one year. It was shown that the correction of the reading to compensate for the deviation in sensitivities by the factor determined for each element is necessary. The elements mostly showed the degradation of sensitivity during the usage. The degradation was caused essentially by the repeated annealing. The values obtained by thermoluminescence dosimetry agreed fairly well with those by film badge monitoring in the wide range of energies higher than several 10 keV. (auth)

15723 GAMMA DOSIMETRY IN THE TEHERAN UNIVERSITY RESEARCH REACTOR CORE. Hamidian, M. R.; Pazirandeh, A. (Teheran Univ., Iran). Atomkernenergie; 22: No. 1, 67-68(Sep 1973).

The RPL property of some materials can be utilized for dosimetry purposes. In the present work the FD-R1-1 glass dosimeter made by Toshiba was used. First, the dosimeter was calibrated using a Victoreen Chamber. The neutron sensitivity of the dosimeter was determined by using Dy foil for absolute flux measurement, and covered glasses with Cd and Sn; the sensitivity was determined to be 1 rem = 10^9 n cm^{-2} s^{-1}. The heating of the dosimeter to 400°C was studied and the sensitivity of heated and unheated glasses is compared. The experimental results show that the FD-R1-1 glass loses about 10% of its dose after 10 minutes at 200°C, about 50% at 320°C and 100% at 400°C for the same heating time. The sensitivity of the fission chamber, used for start-up of the reactor, to γ-radiation was studied. Experimental results show that the fission chamber has a sensitivity of only 0.1% to core gammas compared to fission neutrons, travelled 30 cm in water. The gamma dose distribution inside the fuel element of the reactor during operation and shut-down was studied and compared to the neutron flux distribution. (GE)

15724 DOSIMETRIC USE OF THERMOLUMINESCENCE IN CEMENT IN THE EVENT OF NUCLEAR ACCIDENTS AND IN RADIATION SHIELDING. De Franceschi, L.; Gentili, A.; Sabbatini, V. (CAMEN, Pisa, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 2, 81-87(1972). (In Italian).

Ionizing radiation induces thermoluminescence in a large number of crystalline substances. Response linearity, reproducibility, a moderate fading, independence of energy values, etc. are determining factors in the use of this phenomenon for dosimetric purposes. Its possible practical application was examined in the case of cement with reference to gamma dosimetry in the event of nuclear accidents and the determination of transmission and buildup factors in the case of concrete shields. Data obtained in a series of tests indicating the practical interest of this use of thermoluminescence are presented. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 17357.

15725 (AEC-tr-7506) FOCUSING CRYSTAL SPECTROMETER AT FRIBURG UNIVERSITY. Piller, O.; Beer, W.; Kern, J. Translated from Nucl. Instrum. Methods; 107: 61-77(1973). 34p. Dep. NTIS $3.75.

The construction of a DuMond type curved crystal spectrometer is described. The apparatus is designed to operate with a fixed source. The crystal and collimator are rotated by independent precision gears driven by stepmotors. One step corresponds to a crystal rotation of 0.3''. A magnetostrictive driving mechanism allows interpolation between steps. The complete spectrometer is enclosed in a thermostatic unit. The reproducibility of a measurement within a two day period is shown to be better than 0.1''. The nonlinearity of the system has been calibrated with a Wild T3 theodolite and a Moore table with a precision better than 0.2''. The measurements of many transitions in the decays of ^{183}W and ^{198}Hg in several orders and the application of the energy combination principle allow a very good test of the performances. They have shown that the precision has not been overestimated. As a practical result a new, more precise set of energies for the transitions in ^{182}W below 264 keV is given with reference to the W $K_{\alpha 1}$ and Hg-411,794 keV standards. (auth)

15726 (CEA-CONF-2438) GAMMA SPECTROMETER OF THE RADIOACTIVE ENGINEERING DEPARTMENT. Ferre, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 13p. (In French). (CONF-730557-3). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting for studies of gamma spectrometry; Grenoble, France (7 May 1973).

In the framework of studies of irradiated fuels, the Radioactive Engineering Department has available two gamma spectrometry units which fulfill all the analysis requirements encountered. One of these units is provided with a collimator and enables very high activity samples (whose nature does not permit homogeneous dilution) to be analyzed. An INTERTECHNIQUE MULTI-8 computer operating on-line with the two installations allows data acquisition and processing to be carried out with a minimum of supervision. The modular composition of the units facilitates the immediate replacement of the faulty element in the event of a failure. The operational sequence can be ensured manually. (FR)

15727 (FEI-372) MEASUREMENT OF THE EFFECTIVENESS OF A TIME-OF-FLIGHT NEUTRON SPECTROMETER. Plyaskin, V. I.; Salnikov, O. A.; Trykova, V. I. (Gosudarstvenny] Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A method for the measurement of the absolute efficiency of a scintillation detector for a fast neutron time-of-flight spectrometer is described. For measurement of the absolute current a single crystal spectrometer with a thin stilbene crystal was used. The absolute and relative efficiencies of the detector were measured in the range from 0.2 to 6.2 MeV with a precision no worse than ±4%. (tr-auth)

15728 (IAEA-147, pp 363-371) NEUTRON SPECTROMETRY RESEARCH AT PARC. Natera, M. G.; Navarro, Q. O. (Philippine Atomic Research Center, Diliman, Quezon City). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Current research activities on neutron spectrometry at the Philippine Atomic Research Center are reported. Several related activities which include the construction, installation and improvement of ancilliary facilities are also briefly reported. A list of previous reports on neutron spectrometry research at PARC is given. (auth)

15729 (INIS-mf-720) LOW-BACKGROUND GAMMA SPECTROMETER FOR EXPRESS ANALYSIS OF RADIONUCLIDES IN SOILS, PLANTS, AND FARM PRODUCE. Dimchev, T.; Rajkov, L. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 13p. (In Bulgarian). INIS.

From 2nd national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

A sensitive low-background gamma scintillation spectrometer was constructed for nondestructive analysis of volumetric samples in 2π geometry. With shielding of 45 cm Fe and 2 cm Cu and a scintillation crystal NaI (Tl) 127 × 127 mm the background is reduced below 2 impulses/channel (at a width of 7 keV in the energy range from 250 to 2000 keV. The resolution of the spectrometer is below 10% for volumetric samples at an energy of 1460 keV. The spectrometer is applied successfully for determining the intensity and spectral composition of gamma radiation from different types of soils, geologic materials, ferro-manganese and nickel-manganese concretions, and other materials. Quantitative nondestructive analysis was made of cesium-137 and mountain soils. The spectrometer renders wide possibilities for differential investigations of the gamma radioactivity of farm produce, fodder, fertilizers, soils, bioproducts and others. Conditions exist for its effective application in the investigations on the migration of uranium, thorium, radium, lead and other heavy elements in water, soils, and plants. Its utilization is also possible in activation analysis. (auth)

15730 (JINR-P10-7364) EXPRESS PROGRAM FOR PROCESSING SPECTRA (EPOS). Determination of the Dependence of the Resolving Capacity of the Detector on the Energy. Eler, G.; Gopych, P. M.; Vinel, G. V.; Khabenikht, V.; Vylova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A procedure is described for the automatic determination of the energy dependence of the resolving capacity of a detector. The effect of errors in the simulated halfwidth on the recovery of the doublet parameters with a precision corresponding to the statistical precision of the experimental data is discussed. (tr-auth)

15731 (JINR-P10-7365) EXPRESS PROGRAM FOR PROCESSING SPECTRA EPOS. Analysis of the Spectral Region With Complex Background and Correction of the Apparatus Disturbances in the Individual Channels. Eler, G.; Gopych, P. M.; Vinel, G. V.; Khabenikht, V.; Vylova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Within the framework of the EPOS program a method was developed for the automatic discrimination and exclusion of the background disturbances, the characteristic width of which can be either large or much smaller than the average halfwidths of spectral peaks. (tr-auth)

15732 (JINR-P10-7367) EXPRESS PROGRAM FOR PROCESSING SPECTRA (EPOS) FOR DOUBLET FITTING. Eler, G.; Golych, P. M.; Vinel, G.; Khabenikht, V.; Vylova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A procedure is described for fast doublet fitting based on the method of statistical fitting. The unique characteristics of the algorithm are such that it permits the inherent inclusion of reciprocal bonds, guaranteeing at some stage of the fitting the possibility of self-instruction programs. As a result, precision was attained corresponding with the precision of experimental results. The basic part of the algorithm using the method of statistical fitting is reported in the form of a procedure in the ALGOL-60 language. (tr-auth)

15733 (RL-73-90) SEMINAR ON TECHNIQUES FOR MOMENTUM RECONSTRUCTION. Rosner, R.; Walker, T. G. (eds.). (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1973. 36p. (CONF-730732-1). Dep. NTIS (U. S. Sales Only) $4.00.

From seminar on techniques for momentum reconstruction; Chilton, UK (20 Jul 1973).

The meeting was held to discuss the techniques in use at the Rutherford High Energy Laboratory for the reconstruction of momenta in both bubble chamber and spark chamber experiments. Emphasis was placed on practical implementations rather than on theoretical treatment of the techniques. Two papers were presented in each of the two sessions, as follows: homogeneous magnetic fields (momentum determination in bubble chamber physics and momentum determination in Omega (a superconducting dipole magnet)); inhomogeneous magnetic fields (parameterization of momentum in M7 magnet and momentum fitting for the Birmingham/RHEL K12A experiment). (UK)

15734 MOESSBAUER SPECTROMETER RADIATION DETECTOR. Singh, J. J. (to National Aeronautics and Space Administration). US Patent 3,781,562. 25 Dec 1973. Filed Date 8 Dec 1972. 4p.

A versatile Moessbauer spectrometer with high efficiencies in both transmission and backscattering techniques is described. The heart of the invention is a detector which includes an NaI(Tl) crystal for detecting radiation caused by the Moessbauer effect. The crystal has a hole in its center to allow the collimated incident radiation to pass through and it is coupled through two quartz optical windows to two photomultipliers such that all of the scintillation radiation produced by the radiation detected by the crystal will flow into the two photomultipliers. When used in a transmission technique the sample or scatterer is placed between the incident radiation source and the detector; and when used in a backscattering technique the detector is placed between the incident radiation source and the sample or scatterer such that the incident radiation will pass through the hole in the crystal and strike the sample. (Official Gazette)

15735 TESTING A MODEL GERMANIUM SEMICONDUCTOR GAMMA-RAY SPECTROMETER UNIT FOR RADIOACTIVITY BOREHOLE LOGGING. Nedostup, G. A.; Prokof'ev, F. H. At. Energ. (USSR); 35: No. 1, 54-55(Jul 1973). (In Russian).

A special cryogenic system was constructed to keep the germanium crystal cooled. The unit used double-walled vacuum construction, and is charged with solid nitrogen for operation over a period of 5 to 7 hr. The external diameter of the unit containing the cryogenic system and detector is 85 mm, and the length is 1500 mm. It requires 1.5 to 2 hr to charge the unit with solid nitrogen. The preliminarily amplified signals from the semiconductor unit are sent to the surface for analysis along the chain (2 to 3 km long) holding the unit in the borehole. The spectrometric resolution was 10 to 12 keV for ^{60}Co energies. A number of borehole measurements over a period of 5 to 7 hr showed that the model operated with high stability. Gamma ray spectra of uranium in equilibrium with its decay products were taken on models of strata. The unit can be used to estimate the content of hydrogen, iron, silicon, calcium and other elements in various strata. (SJR)

15736 MOESSBAUER BIREFRINGENCE ROTATION POLARIMETER. Pfannes, H. D.; Gonser, U. (Univ., Saarlandes, Saarbruecken, Ger.). Nucl. Instrum. Methods; 114: No. 2, 297-299(1974).

A Moessbauer polarimeter is described to measure birefringence rotation. This convenient method is based on a rotating Moessbauer source, emitting linearly polarized recoil-free γ-rays. The counts are accumulated in a multichannel analyzer with each channel corresponding to a well-defined angle position between source (polarizer) and absorber (analyzer). This fully automatic measuring procedure avoids perturbations originating from single channel analyzer drifts. High precise values of birefringence rotations can be obtained by a least square sinusoidal fit procedure of the resulting "Malus curve". (auth)

15737 DIFFRACTION SPECTROMETER FOR STUDIES OF PARTICLE EXCITED RADIATIVE TRANSITIONS. Jett, J. H.; King, N. S. P.; Lind, D. A.; Henning, P. (Univ. of Colorado, Boulder). Nucl. Instrum. Methods; 114: No. 2, 301-312(1974).

The installation and operation of a curved crystal diffraction spectrometer to measure prompt gamma radiation generated by charged particle beams is described. Germanium [422] and [220] planes have been used; a comparison over a limited energy range of measured reflectivity is made with theory. Several examples of spectra generated by (p,xn) reactions indicate that the technique is well suited to studies of gamma rays with energy less than 500 keV. (auth)

15738 SHAPE OF SPECTRAL LINES: ANALYTIC DECONVOLUTION AND MATCHING OF PEYRE-PRINCIPI PROFILES. Middendorf, H. D. (King's Coll., London). Nucl. Instrum. Methods; 114: No. 2, 397-399(1974).

Line shapes given by convolution integrals are approximated by superimposing Gaussian and Lorentzian profiles. Relations between half-widths, peak and total intensities are discussed and explicit deconvolution schemes are described. (auth)

15739 127° ELECTROSTATIC ANALYZER: PERFORMANCE AS A SPECTROMETER. Bryce, P.; Dalglish, R. L.; Kelly, J. C. (Univ. of New South Wales, Sydney). Can. J. Phys.; 51: No. 5, 574-586(1 Mar 1973).

The basic design and performance characteristics of a 127° electrostatic analyzer are derived from an exact solution of the potential within a bounded two-dimensional cylindrical sector. The results are compared with those found from radial field theory, to show that transmission is nonsymmetric in both energy and incident angle about the "tuning" and "normal" values respectively. Except for normally incident particles the usual radial-field calibration equation cannot be relied upon unless the analyzer design is altered to minimize end aberrations. Modified beam entry conditions are given to optimize the performance of the analyzer. (auth)

15740 CONVERSION-ELECTRON SPECTROSCOPY OF SHORT-LIVED NUCLIDES. Zolnowski, D. R.; Sugihara, T. T. (Texas A and M Univ., College Station). Nucl. Instrum. Methods; 114: No. 2, 341-347(1974).

A simple technique for obtaining conversion-electron spectra of short-lived activities with a Si(Li) detector is described. The method employs the helium-jet technique to produce sources repetitively for subsequent counting through a 0.90 mg/cm^2 aluminized Mylar window. The effects of the Mylar window on resolution and line shape were investigated and shown to give acceptable results for electron energies as low as 85 keV. The most probable energy loss for electrons of energies 85, 109, 253, 292, and 389 keV was found to agree reasonably well with theoretical predictions. Conversion-electron spectra of ^{177m}Hf (1.1 s) and ^{152m}Tb (4.2 min) are shown. For the latter nucleus, transition multipolarities deduced from experimental internal-conversion coefficients were found to support spin and parity assignments made previously. (auth)

15741 PROPORTIONAL COUNTER CHARACTERISTICS, AND APPLICATIONS TO REACTOR NEUTRON SPECTROMETRY. Verbinski, V. V.; Giovannini, R. (Intelcom Rad Tech, San Diego, CA). Nucl. Instrum. Methods; 114: No. 2, 205-231(1974).

A critical, comparative study was made of gas-filled proton-recoil spectrometers as applied to measuring neutron spectra in reactors by measuring some responses of different types of counters to monoenergetic neutrons and comparing these with the calculated responses, by measuring reactor spectra with different counter geometries and filling gases, and by unfolding the data with a variety of spectrum-unscrambling codes. Prior to these measurements, supporting measurements were made to determine the effectiveness of γ-ray-background rejection schemes, to optimize the detector resolution, and to measure the time-slewing and the gas-gain versus counter voltage. Measurements of counter response to monoenergetic neutrons were compared to calculated responses for different counter geometries and recoil-proton ranges. These were used to assess electric-field distortion effects for different counter designs, since the wall-and-end effects were found to be calculable to very good accuracy. This study led to the concept of a hybrid counter that is proposed. This design minimizes field-distortion effects by a large factor for the small counters used in measuring reactor spectra. In addition to evaluating counter designs, the response measurements provide accurate, basic data on the relationship between ionization and energy for both the hydrogen and the methane gas fillings. A reactor-core neutron spectrum measured with

the 4π proton recoil counter is compared to a time-of-flight measurement of directional flux to illustrate the accuracy of these two complementary methods. (auth)

15742 MEASUREMENT OF LINEAR POLARIZATION OF COHERENT BREMSSTRAHLUNG BY DETECTING THE ANGULAR CORRELATION IN PAIR PRODUCTION. Kondo, K. (Tokyo Univ.); Miyachi, T.; Yamamoto, A.; Gotow, K.; Yoshida, H.; Inaba, S.; Kurokawa, S.; Muramatus, H.; Sasao, N.; Suzuki, S.; Kobayashi, M.; Iwata, S. Nucl. Instrum. Methods; 114: No. 2, 365-373(1974).

The linear polarization of the coherent bremsstrahlung from a single crystal of silicon was measured by observing the one-dimensionally projected angles of electron and positron pairs. The coherent bremsstrahlung was produced by injecting the 1153 MeV electrons to the silicon crystal nearly along the [110] axis. The emission angles, $\eta+$ and $\eta-$, of pair particles were determined event by event by observing their tracks with a set of four wire spark chambers. From the $(\eta+, \eta-)$ distribution of events, the polarization of photons was evaluated. The obtained polarization was consistent with the calculated values, and the technique gives a new approach to the measurement of the linear polarization of photons. (auth)

15743 GAMMA RAY ENERGIES AND INTENSITIES FOR CALIBRATING Ge(Li) DETECTORS IN THE RANGE 3 TO 10 MeV. Sokolovskii, L. L.; Ignatochkin, A. E. (Inst. of Atomic Energy, Moscow). pp 431-435 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

Ge(Li) detectors are being used more for measuring gamma ray spectra over a wide energy range. The high resolution of such detectors entails certain requirements as the accuracy of the calibration curves, so that it is essential to establish an appropriate set of standards for the energy and intensity calibration of Ge(Li) detectors at energies up to 10 MeV. At energies up to 3 MeV, Ge(Li) detectors are calibrated using the gamma rays from sources whose energies and intensities are well known from recent precision measurements performed with magnetic and crystal spectrometers. However, the range of gamma energies investigated in nuclear reactions extends to 10 MeV, and as there are very few calibration curves for these higher energies it becomes much more difficult to work with Ge(Li) detectors. The present situation as regards the calibration of Ge(Li) detectors in the range 3 to 10 MeV and the standards used by various workers in determining the energy of a particular radiation and measuring the relative efficiency of Ge(Li) spectrometers are discussed. Revised tables are presented of gamma transition energies and intensities in the reaction (n,γ) for the elements most frequently used as standards. (auth)

15744 ALGORITHM AND PROGRAM FOR ANALYSIS OF GAMMA SPECTRA BY THE LEAST-SQUARES METHOD. Pegoev, A. N. Tr., Inst. Eksp. Meteorol.; No. 1, 122-129(1972). (In Russian).

The least-squares method ensures a lower error in spectral analysis than any other method. This method, in the approach to the problem of analysis of gamma radiation spectra determined with a scintillation spectrometer, requires the introduction of a weighting factor for counting in the channels. Contents of natural radioactive elements in the soil and ores and errors of these values according to the spectrum measured with a 64-channel analyzer were calculated in 3 sec. The correctness of the calculations and operation of the spectrometer were monitored by the ratio of the actual and calculated deviations of the counts in the channels. (tr-auth)

15745 COMPARISON OF METHODS FOR ANALYZING GAMMA SPECTRA. Pegoev, A. N. Tr., Inst. Eksp. Meteorol.; No. 1, 130-136(1972). (In Russian).

Statistical errors are calculated for the gamma spectrometric determination of the natural radioactive element content of soils or rocks with different methods of processing the spectra. Comparison of these errors indicates that the most expedient use, in manual processing of spectra, of methods of separating counts in different energy ranges with subsequent resolution of the system of linear equations and in machine processing is the least-squares method. Based on the dependence of the error on the number of channels of the analyzer, it is concluded that the analyzer should have at least two channels at the photopeak width. (tr-auth)

High Energy Physics Instrumentation

Refer also to abstract 16439.

15746 (ANL-8055) STREAMER CHAMBER TECHNOLOGY. Proceedings of the First International Conference, September 14-15, 1972. Watson, J. M. (ed.). (Argonne National Lab., Ill. (USA)). 1972. Contract W-31-109-eng-38. 258p. (CONF-7209102-). Dep. NTIS $7.60.

A separate abstract was prepared for each of the 16 papers presented at the conference. (WHK)

For abstracts of individual papers see: 15747-15762.

15747 (ANL-8055, pp 1-15) PERFORMANCE OF THE SLAC STREAMER CHAMBER. Bunnell, K.; Mozley, R. F.; Odian, A. C.; Villa, F.; Wang, L. C. (Stanford Linear Accelerator Center, CA). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

The past, present, and future uses of the SLAC streamer chamber system are discussed. Descriptions of the various experiments are given along with the hydrogen targets, the Marx generator and the Blumleins. The relative successes and failures of the various components are discussed and illustrative photographs of events are presented. The operating characteristics of the system are also presented with particular attention given to the problem of flares. (auth)

15748 (ANL-8055, pp 17-28) UCLA-LBL STREAMER CHAMBER FACILITY. Grigorian, A. (Univ. of California, Los Angeles); Ladage, A.; Mellema, D. J.; Rudnick, F. D.; Stork, D. H.; Ticho, H. K.; Eckman, G. J.; Hunt, D. B.; Peters, R. 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

The UCLA-LBL streamer chamber facility presently located in beam channel 26B of the LBL Bevatron is described. (auth)

15749 (ANL-8055, pp 29-41) UNIVERSITY OF WASHINGTON STREAMER CHAMBER. Cook, V.; Gregg, R.; Jonckheere, A. M.; Kenyon, R.; Lubatti, H. J.; Rohrbach, F. (Univ. of Washington, Seattle). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

General design and operating parameters for the chamber are presented. It is essentially the same as the SLAC system. (TFD)

15750 (ANL-8055, pp 42-52) UNIVERSITY OF ILLINOIS-A.N.L. STREAMER CHAMBER SYSTEM. Sokolsky, P. (Univ. of Illinois, Urbana). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

A 1.5 m × 1.0 m × 60 cm streamer and pulsing system capable of 1.0 MV, 10 to 20 nsec pulses have been developed by a University of Illinois—Argonne National Laboratory group. Two experiments have been performed using the system. Pulse amplitude stability at the level of 2 to 3% rms has been achieved. The apparatus is described and operating experience summarized. (auth)

15751 (ANL-8055, pp 53-68) INFORMAL INVITED TALK ON STREAMER CHAMBER TECHNOLOGY. Odian, A. C. (Stanford Linear Accelerator Center, CA). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

Problems encountered in streamer chamber technology are reviewed. Problems in photography, Marx generators, Blumlein lines, jitter and other power supply problems, "flares" (anything that muddies up the picture), targets, and data analysis are discussed. Future technology possibilities are outlined. (WHK)

15752 (ANL-8055, pp 69-80) STREAMER CHAMBER MISSING MASS SPECTROMETER FOR STUDY OF DIFFRACTIVE DISSOCIATION AT NAL. Cook, V. (Univ. of Washington, Seattle); Gregg, R.; Jonckheere, A. M.; Kenyon, R.; Lubatti, H. J.; Rohrbach, F.; Fournier, D.; Jacquet, F.; Veillet, J. J. 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

A missing mass spectrometer for the study of diffractive dissociation at NAL which uses a streamer chamber filled with ^{4}He as target and detector is described. (auth)

15753 (ANL-8055, pp 81-102) TECHNICAL PROBLEMS INVOLVED IN H_2 STREAMER CHAMBERS. Rohrbach, F. (Univ. of Washington, Seattle); Bonnet, J. J.; Cathenoz, M. 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

Technical difficulties which must be resolved in order to develop

a working H_2 streamer chamber for elementary particle research are discussed. It was found that the minimum requirements for the high voltage pulse are: amplitude 70 to 80 kV/cm for pure hydrogen (~60 kV/cm with SF_6 or CH_4 impurities) at atmospheric pressure, duration lower or equal to 6 ns at the base of the pulse and reproducibility better than 2%. A very fast pulse with rise time less than 2 ns and less than 1% jitter has been obtained by using an electrostatic high voltage generator (up to 600 kV) feeding a conical Blumlein line switched at the tip of the cone by a high pressure triggered radial spark gap. With this equipment good pictures of tracks in hydrogen were obtained in a 9 cm gap chamber at various H_2 pressures up to 0.4 atmosphere. The effect of impurities and mixtures on track quality in H_2 have been studied. Comparison with He and He–Ne (75%) gas are given. (auth)

15754 (ANL-8055, pp 103-116) ARGONNE NATIONAL LABORATORY MICROWAVE DISCHARGE CHAMBER PROJECT. Kustom, R. L.; Fuja, R. E.; Chang, C. T. M. (Argonne National Lab., IL). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

The use of a microwave discharge mechanism in a dense gas streamer chamber is discussed. (The dense gas is an efficient target.) The state of equipment development and a description of the discharge mechanism are discussed. (WHK)

15755 (ANL-8055, pp 117-120) FIVE METER MAGNETIC SPECTROMETER BASED ON A STREAMER CHAMBER. Bohm, G.; Vertogradov, L. S.; Grishkevich, Ya. V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

Development of a five-meter magnetic spectrometer, based on a streamer chamber with a liquid hydrogen target is outlined. The spectrometer is called RISK (Relativistic Ionization Streamer Chamber (Kamera)) because it is proposed to measure the velocity of relativistic particles by means of their ionization energy loss as an aid in their identification. The spectrometer will be used for the study of high-energy hadron interactions at the Serpukhov Synchrotron. The status of the project is summarized. (WHK)

15756 (ANL-8055, pp 121-126) STREAMER CHAMBER FILLED WITH ^{3}He. Falomkin, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR); Korolyov, V. P.; Kulyukin, M. M.; Lyashenko, V. I.; Piragino, G.; Pontecorvo, G.; Shcherbakov, Yu. A. 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

For a number of experiments on pion scattering it is necessary to use a streamer chamber filled with ^{3}He. The experimental setup used for investigation of the elastic and inelastic scattering of pions on ^{3}He at energies of 100 to 200 MeV is described. (auth)

15757 (ANL-8055, pp 127-134) 4 NSEC, 100 kV SQUARE PULSE GENERATOR. Gygi, E.; Schneider, F. (CERN, Geneva). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

A description is given of a generator which produces pulses up to 100 kV on a 20 Ω load. The pulse duration is 4 nsec, the rise and fall time 0.6 nsec and the repetition rate 1 Hz. (auth)

15758 (ANL-8055, pp 135-139) STREAMER CHAMBER FAST CHARGE AND REGULATING SYSTEM. Fuja, R. E.; Dawson, J. W. (Argonne National Lab., IL). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

The specifications for pulse to pulse repeatability, imposed by a streamer chamber built at Argonne National Laboratory, place stringent requirements on the Marx generator charging electronics. The system philosophy, design requirements, and circuit configurations are discussed. (auth)

15759 (ANL-8055, pp 140-149) FOAM-INSULATED LIQUID HYDROGEN TARGET FOR THE ANL–UNIVERSITY OF ILLINOIS CHAMBER. Watson, J. M.; Sevcik, V.; Giugler, R.; Peifer, J. (Argonne National Lab., IL). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

The design and performance of a liquid hydrogen target used within the sensitive volume of the ANL-U. of Illinois streamer chamber are described. A vacuum jacket of polyvinylchloride foam was used for thermal and electrical insulation. None of the high voltage problems of earlier designs was encountered. (auth)

15760 (ANL-8055, pp 150-166) IONIZATION MEASUREMENTS WITH STREAMER CHAMBERS. Morrison, R. W. (Carleton Univ., Ottawa). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

Previous attempts to relate streamer density to ionizing power at minimal high-voltage pulse delay are discussed. An experiment designed to measure the sensitivity of streamer density to ionizing power at pulse delays of 20 μsec is reported. Tracks of positive and negative particles at 1120 and 1400 MeV/c were photographed in a Ne–He streamer chamber filled with 90% Ne–10% He, on Kodak 2485 and SO340 film at f/2. Streamers were counted on a fiducial length of 73 cm. The overall width of the streamer density distribution was about 12%. However, predicted differences in ionizing power of up to 25% were not observed. (auth)

15761 (ANL-8055, pp 167-187) STREAMER DISCHARGES IN STREAMER CHAMBERS, TRANSVERSE LASERS, AND LASER TRACK CHAMBERS. Morrison, R. W. (Carleton Univ., Ottawa). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

Streamer growth in neon-helium and pure helium was studied in the following stages: avalanche, cylindrical streamer, brush discharge, and plate-to-plate discharge. Applications to bright and dark regions on streamers, resolution, propagation velocity, volume ionization, and transverse lasers are discussed. An unsuccessful search for particle tracks made visible by a TEA CO_2 laser is reported. (auth)

15762 (ANL-8055, pp 188-207) MIDGAP STREAMER FORMATION IN STREAMER CHAMBERS. Risk, W. S. (Univ. of Maryland, College Park). 1972.

From first international conference on streamer chamber technology; Argonne, Illinois (14 Sep 1972).

In streamer chamber technology.

A description is presented of streamer formation in high-energy physics streamer chambers. While the streamers in these chambers are used to record trajectories of charged particles passing through them, the shape of the streamers themselves offers additional insight into the avalanche-streamer formation process. Modifications to the qualitative features of older descriptions of this process are made to account for the observed phenomena. (auth)

15763 (ITEF-23) INCREASE OF PRECISION IN RE-ESTABLISHMENT OF COORDINATES DURING PHOTOGRAPHING THROUGH REFLECTING AND REFRACTING SURFACES. Kishkurno, V. V.; Krutenkova, A. P.; Kulikov, V. V.; Nikolaeva, L. P.; Radkevich, I. A.; Fedorets, V. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

For photography of spark chambers placed under the magnet slit of the ITEF three-meter spectrometer, a mirror system was established. This system made it possible to equalize the optical track from one spark chamber occurring at a relatively large distance from another spark chamber and to reduce by six times the dimensions of the image on the film because of the elimination of the void space. Because of this it was possible to use narrow format 35 mm film with a standard small-angle objective and a commercial photo apparatus. By increasing the density of the data entry it was possible not only to substantially reduce the film expense but to increase the rate of film processing in the automatic scanning device. Photographing images through pairs of mirrors introduces supplementary errors in the results of the measurement of the spark coordinates. These errors are not small, but for cost reduction of the apparatus, mirrors of not very high quality were used. The correction system made it possible to introduce comparatively simple corrections to the mirror aberrations and to the distortions in the outer walls of the chamber. The precision obtained was practically the same as in direct photography of objects. (tr-auth)

15764 (ITEF-25) INVESTIGATION OF THE RE-ESTABLISHMENT OF IMPULSE ELECTRICAL STRENGTH AFTER DISCHARGE IN SPARK CHAMBERS WITH SMALL CLEARANCE. Martynov, V. I.; Ryl'tsov, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The curves for the re-establishment of the impulse electrical strength, measured at two different electrode clearances (1.0 and 0.6 cm), are reported as a function of the electrical conditions and the composition of the gaseous mixture at atmospheric pressure. The spark chamber was filled with Ne–He, Ne, or He with admix-

tures of several percent of ethyl alcohol, isopropyl alcohol, and 0.01% Freon-12 vapors. Disregarding the slowly decreasing part of the recovery time curves at clearing field voltages from 10 to 100 V/cm, the de-ionization time at both clearances can be described by the equation $T = \tau + d/\mu E$, where T is the extrapolated value of the recovery time, and τ and μ are constants, arising during the interpolation of the experimental dependencies. The size of τ is roughly equal to 1 msec, μ is about 2 cm^2/V sec, d is the clearance between electrodes in cm, and E is the clearing field voltage in V/cm. The interpretation of the results was done by analogy with the interpretation of processes occurring the usual gas-discharge counters in post-discharge period. (tr-auth)

15765 (ORO-2504-186) LARGE VOLUME 96 ELEMENT DIGITIZED NEUTRON DETECTOR. Technical Report No. 73-021. Aitkenhead, W.; Christian, J.; Crouch, J. H.; LaRue, G.; Lyerly, M.; Pappas, P.; Risk, W. S. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Aug 1973. 38p. Dep. NTIS $4.00.

A large neutron detector containing 96 liquid scintillation counters is described. The detector was used in measuring the threshold cross-section for the reaction $\pi^+p \rightarrow \pi^+\pi^+n$. The counters are 47 cm × 17 cm × 17 cm rectangular Plexiglas boxes filled with pseudocumene based liquid scintillator. 96 four-fold coincidence latch circuits are used to form coincidences between the two phototubes viewing each counter, and record on magnetic tape counter location and neutron time of flight information. Details on the design, construction and performance of the array are presented. (auth)

15766 METHOD TO STUDY THE CHARACTERISTICS OF NUCLEAR INTERACTIONS OF COSMIC RAY PARTICLES OF DIFFERENT NATURE WITH ENERGIES EXCEEDING 10^{12} eV. Grigorov, N. L.; Mitoyan, S. V.; Savel'eva, A. I. (Erevan Polytechnic Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 2, 93-99(1973). (In Russian).

A method to study the characteristics of nuclear interactions initiated by particles of different nature of energy $E_0 > 10^{12}$ eV on the ionisation calorimeter with controlled nuclear photoemulsions facility is given. The method described allows a determination of the genetic connections of high-energy γ-rays at large distances (R ~ 5 m) to be made. The criteria of interaction selection in carbon producers are given. The experimental data on counting rates of observed interactions initiated by high-energy hadrons of different nature are given. (auth)

15767 MULTIPLE EFFICIENCY OF CURRENT LIMITED SPARK CHAMBERS. Bull, R. M.; Henshaw, D. W.; Youle, J. H. (Univ. of Nottingham, Eng.). Nucl. Instrum. Methods; 114: No. 2, 375-380(1974).

Current limited spark chambers have the particular advantage that they record events involving many particle tracks. This property has been investigated using indirect methods and it is concluded that the external experimental conditions (rather than the intrinsic properties of the chambers) provide the upper limit to the particle densities that can be recorded. It is suggested that, at particle densities in excess of $10^6 m^{-2}$, anomalous behavior of the chambers might be expected. (auth)

15768 PHYSICS RUN WITH AN ALL PLEXIGLAS TRACK SENSITIVE TARGET. Coleman, T. G. (Rutherford High Energy Lab., Chilton, Eng.); Fisher, C. M.; Fitzharris, E. W.; Foster, J. H.; Guy, J. G. V.; Williams, P. R.; Leutz, H.; Thevenon, M.; Tischhauser, J.; Wenninger, H. Nucl. Instrum. Methods; 114: No. 2, 381-383(1974).

A track sensitive target constructed entirely of Plexiglas has been used in the RHEL 1.5 m cryogenic bubble chamber to take over 500,000 physics pictures. 80 and 82 mol % neon were employed in the surrounding mixture with hydrogen in the target. This target is contrasted with the earlier composite one. (auth)

15769 NAL 30-INCH BUBBLE CHAMBER-WIDE GAP SPARK CHAMBER HYBRID SYSTEM. Smith, G. A. (Argonne National Lab., IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 500-519 (1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A description is given of the physical characteristics of the Experiment 2B hybrid spectrometer now operating at NAL, consisting of the 30-inch bubble chamber and wide-gap optical spark chambers. Details of the equipment and operating conditions are presented. Further details of track reconstruction and bubble chamber/spark chamber hookup software are presented, along with results for 15 and 200 GeV/c tracks. (auth)

15770 TRACK SIMULATION IN A CURRENT-LIMITED SPARK CHAMBER. Bull, R. M.; Youle, J. H. (Nottingham Univ., Eng.). J. Phys., D (London); 6: No. 18, 2226-2235(5 Dec 1973).

A technique for simulating charged particle tracks in spark chambers is described. The method is extremely versatile, and several of its applications are outlined. The technique depends on the production of long-range ultraviolet photons in a spark. The mean free path of these photons in a neon–helium gas mixture is measured as 9.0 cm. (auth)

15771 ENERGY DEPOSITION AND ENERGY-DEPOSITION FLUCTUATIONS IN AN IONIZATION SPECTROMETER AND A TOTAL-ABSORPTION NUCLEA-CASCADE COUNTER. Gabriel, T. A.; Chandler, K. C. (Oak Ridge National Lab., TN). Particle Accel.; 5: No. 3, 161-169(1973).

Calculations have been carried out to determine the energy deposition and energy-deposition fluctuations produced by incident 28-GeV/c protons on an ionization spectrometer. In obtaining the pulse-height characteristics of the spectrometer, the nonlinearity of the light pulses is taken into account by the use of Birks' law and is shown to be of importance. A discussion of the experimental difficulties encountered in locating the position of the initial proton interaction within the spectrometer is also presented. Similar calculated results on the energy deposition and energy-deposition fluctuations are presented for 8-GeV/c negative pions incident on an NaI(Tl) total-absorption nuclear-cascade (TANC) counter. Also included for 8-GeV/c incident negative pions is the laterally integrated energy deposition as a function of depth in a tin absorber. In general, the calculational approach used is shown to yield good agreement with the experimental data. (auth)

Radiometric Instruments

15772 (TID-3338) RADIOMETRIC GAGES. A Bibliography. Kinser, W. H. (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 125p. NTIS $5.45.

794 references to reports and published literature on the design, operation, and uses of radiometric gages in industry, hydrology, civil engineering, and in the laboratory are presented. The references were obtained from Nuclear Science Abstracts, Volume 21 (1967) through Volume 27, issue 12 (June 1973). Abstracts of the papers are presented; and corporate author, report number, personal author, and subject indexes are included. (WHK)

15773 RADIOACTIVITY WELL LOGGING METHODS AND APPARATUS. Schuster, N. A. (to Schlumberger Technology Corp.). US Patent 3,784,822. 8 Jan 1974. Filed Date 13 Jul 1971. 10p.

An illustrative embodiment of the invention compensates neutron measurements of the porosity of an earth formation for sudden changes in borehole diameter. Typically, a sidewall porosity logging tool for transport through a borehole is equipped with two neutron detectors spaced at different distances from the neutron source. In order to improve the vertical resolution of the tool, a circuit stores the signal from the longspaced detector until the shorter spaced detector has traversed a distance along the borehole wall that is equal to the separation between the two detectors. This memory feature adjusts the porosity signals to a common zone of observation. These apparent porosity signals then are combined with borehole caliper signals to compensate for the effect of changes in borehole diameter. (Official Gazette)

15774 GAMMA RAY DENSITY PROBE DESIGNED FOR USE IN AN UNCASED EXPLORATION HOLE. Preiss, K.; Lahat, A. Geotechnique; 22: No. 4, 663-666(Dec 1972).

A gamma ray probe was developed to measure the density in uncased rough exploration holes. The probe consists of a scintillation detector with a NaI(Tl) crystal, separated by 15 cm of lead from a 0.5 mCi ^{137}Cs source. The observation is performed by pressing the probe on the side of the drilled hole in the soil by inflating an air-filled balloon. The density is measured, using a calibration curve obtained on site, by plotting count ratios as a function of density determined by sand replacement. This new experimental method applied in uncased exploration holes simplifies preceding methods where a casing of constant section with no air gap between tube and soil is required. The analysis of the field calibration shows that the method is at least as accurate as the sand replacement test. In the case where the same satisfactory coincidence between experimental results obtained by the gamma ray density probe and the sand replacement method is verified by further measurements on different soil types, the present study constitutes a convenient method for the determination of the density of soils. (Appl. Mech. Rev.)

15775 USE OF NUCLEAR DATA IN THE DESIGN OF RADIATION INSTRUMENTS FOR MINERAL EXPLORATION AND MINING. Clayton, C. G.; Sanders, L. G. (Atomic Energy Research

Establishment, Harwell, Eng.). pp 391-410 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 2); CONF-730302-(Vol. 2).

The increasing use of nuclear techniques for mineral analysis in a wide variety of environments associated with mineral prospecting and mining has emphasized the need for the presentation of nuclear data in a form which allows rapid assessment of the analytical problems. A number of applications in the field of minerals are identified and an example of the use of nuclear data for resolving a typical analytical problem and of the difficulties in applying existing compilations is given. A form of presentation of relevant nuclear data for use in this type of problem is proposed. (auth)

15776 USE OF NUCLEAR DATA IN DESIGNING SPACE-SCIENCE EXPERIMENTS. Clark, B. C.; Kase, P. G.; Martin, J. P.; Morse, J. G. (Martin Marietta Aerospace, Denver). pp 577-594 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

Scientific experiments for exploration of the planets and interplanetary space must be designed to operate in a number of severe environments, including the natural radiation in space (cosmic rays, solar flares, radiation belts, etc.). Man-made radiation environments may be also present, such as gamma and neutron emissions from radioisotope thermoelectric generators (RTG's) used as spacecraft power supplies, and/or emissions from radiation sources which are a part of the science instrumentation complement. Examples of the latter include alpha, beta, x-ray and radioisotope sources, miniature x-ray tubes, and neutron generators of the D-T accelerator type. Each experiment must survive the radiation damage as well as interferences during operation in such environments. The use of nuclear data in designing several instruments for exploration of Mars and Venus is discussed, with examples drawn from the x-ray fluorescence geochemical analyzer scheduled for launch to Mars in 1975, plus an x-ray diffractometer, a gamma-ray spectrometer, and a neutron activation analyzer under study for possible use on future missions. Constraints upon overall spacecraft design due to the nuclear environments are also discussed. The types of nuclear data employed include radioisotope emission characteristics, shielding of sources, shielding of cosmic rays and trapped particles, neutron scattering and activation cross-sections, and gamma-ray transport parameters. High costs in fully simulating such environments for spacecraft-sized equipment have dictated heavy reliance upon analysis rather than experimental test in verifying spacecraft compatibility. This greatly increases the economic value of the applicable nuclear data. (auth)

15777 ISOTOPE MEASURING SYSTEMS REDUCE RAW MATERIAL COSTS. Kowalski, E. (Landis und Gyr AG, Zug, Switzerland). Contr. Instrum.; 5: No. 11, 28-33(Dec 1973).

Since the early 1950's isotope measuring techniques have found wide acceptance in industrial process control. The technical advantages and examples of the application of the contact-free operating isotope measuring system are listed. To determine the basic weight per unit area of a material the method of radiation reflection from the measured product is outlined. Feedback of information obtained by these methods to control coating thickness in continuous processes is considered. A variety of measuring problems which have been overcome by the use of isotope techniques are listed and the importance of cost benefit analysis of the systems is stressed. It is considered that isotope techniques (a) save raw material through improved production accuracy and the resulting ability to supply nearer to the order specification, (b) reduce waste through improved production accuracy, (c) increase productivity, particularly due to reduced downtime when changing to a new product size, servicing machine, etc., (d) save working time by using contact free measurement processes which previously had to be manually controlled, and (e) entail low installation costs. (UK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 16387.

15778 (PEM-1) EMP PROTECTION ENGINEERING: THE NEED FOR DOCUMENTATION. Wouters, L. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1972. 8p. Dep. NTIS $3.00.

The diversity of knowledge and need for a common format are reviewed. The problems of preparing the first DASA EMP handbook, where to get material, how to organize and categorize it—originally as system engineering aspects, circuit layout, shielding and bonding, cabling, grounding, protective devices, and susceptibilities are discussed, as well as the general problem of a bibliography of EMP system and hardware practices. (auth)

15779 (PEM-2) EMP DIRECTORY FOR SHELTER DESIGN. Bridges, J. E.; Miller, D. A.; Valentino, A. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1971. 40p. Dep. NTIS $4.00.

General historical and educational material about EMP are presented. The material is oriented toward the design of a shelter for civil defense. It is broad in its treatment and outlines the worst case viewpoint, including threat assumptions, EMP energy collectors (such as cables, piping, conduit, antennas, towers, wires, exposed metallic sheets, and structural members), component degradation (minimum energy for burnout viewpoint) and a discussion of isolation requirements. Hardening approaches for shelters include shielding, and the problems of penetrations, quality control and maintenance. Much descriptive and qualitative information is presented. (auth)

15780 (PEM-17) CONNECTOR DESIGN AND TEST PRACTICES. Cook, D. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. 15p. Dep. NTIS $3.00.

Practical philosophy for selection of connector designs and problems encountered in ordinary off-the-shelf designs is outlined. Included are necessary design modifications, process controls, quality controls, and testing to achieve EMP protection requirements. Currently MIL-C-38999 connector Series II with modifications as described is considered preferred for missile applications. The grounding spring attachment technique is not specified by most MIL. Specs. Plating of connector shell components is also a problem. Included are several diagrams illustrating the Series II and Series I connectors, electrical interface points, solder design, magneform design, a typical grounding test diagram, and lists of qualification tests, such as aging, engaging, separating, mating forces, contact resistance, dielectric, insulation, etc. (auth)

15781 EFFECT OF NEUTRON AND GAMMA RADIATION ON THE PARAMETERS OF METAL-DIELECTRIC-SEMICONDUCTOR (MDS) STRUCTURES. Girii, V. A.; Pasechnik, V. M.; Stepanenko, V. A.; Khrapachevskii, V. N.; Shakhovtsov, V. I. At. Energ. (USSR); 35: No. 1, 48(Jul 1973). (In Russian).

The contribution of absorbed energy from the neutron and gamma components of reactor radiation was calculated, and the change in threshold voltages noted on p-type structures of Si/SiO_2/Si_3N_4/Al. The effect of irradiation was estimated from the change in threshold voltage. The metal/dielectric/semiconductor (MDS) structures were made of n-Si with ρ_V = 4.5 ohm · cm.; the layer thicknesses of SiO_2 and Si_3N_4 were the same at 500 A. The data for reactor and pure gamma irradiation with ^{60}Co show that for both types of radiation at an integral neutron flux of 10^{14} neutrons/cm^2 and a gamma dose of 10^6 rads the effects coincide both qualitatively and quantitatively. This result indicates that the gamma radiation has a proportionately greater effect than the neutron radiation on the properties of MDS structures. Calculations showed that the absorbed neutron dose in the SiO_2 and Si_3N_4 layers was 0.08 rads/sec while the absorbed gamma ray dose was 2.15 rads/sec. (SJR)

15782 MEASUREMENT OF TEMPERATURES OF MATERIALS UNDER IRRADIATION. Review. Markina, N. V.; Samsonov, B. V. At. Tekh. Rubezhom; No. 3, 38-44(1973). (In Russian).

The use of temperature-measuring instruments and the results of studies of their behavior and efficiency in a reactor radiation field are reviewed. Electrical methods for measuring temperature (thermocouples and resistance thermometers), nonelectric methods (bimetallic thermometers, clinical thermometers, and silicon carbide and diamond monitors), and "Templug" data units are discussed. The conclusion was reached that in instrumented reactors, the temperature is more expediently measured with a thermocouple made from carbide. With a thermal neutron flux of $< 5 \times 10^{13}$ n/cm^2/s, the error is about 2%. For noninstrumented reactors the recommended monitors are: up to 800°C, diamond; 600 to 1200°C, silicon carbide. Limited use of a bimetallic thermometer is possible, but a record of the reactor operating regime is necessary. "Templug" type monitors are recommended for the 450 to 650°C range. (tr-auth)

Miscellaneous Instruments

Refer also to abstracts 16338 and 17625.

15783 (BNL-18417) STABILITY OF BUNCHED BEAMS AGAINST HIGH ORDER NONLINEAR RESONANCES. Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 7 Dec 1973. 14p. Dep. NTIS $3.00.

For a given tune, beams can be made stable against the effects of isolated high order resonances. However, in a system whose betatron tune is changing, there exists a mechanism for beam loss. This mechanism is discussed and applied to the case of bunched beams, where the synchrotron motion introduces a time variation of tune. A stability criterion for a system with varying tune is presented, together with a set of suggested parameter values. The basic constraint is that the linear tune spread in the bunches (arising through the chromaticity) be smaller than the nonlinear tune spread (arising from the nonlinearities of magnetic field as well as the beam-beam interaction). This can be achieved with a small chromaticity and a relatively large nonlinear term causing a tune spread with betatron amplitude. Specific values for chromaticity and nonlinearity are suggested. A limit on the resonance excitation strength is also given. Since the beam-beam interaction introduces a tune spread with amplitude, then in some range it is found to have a stabilizing influence insofar as isolated high order nonlinear resonances are concerned. This point is discussed together with a brief discussion on the onset of stochastic phenomena, which are due to the interaction of many resonances. It is concluded that with the given set of parameters, bunched beams stable against high order nonlinear resonances can be achieved. (auth)

15784 (BNL-18431) COMPARISON OF WIND SPEED AND TURBULENCE MEASUREMENTS MADE BY A HOT-FILM PROBE AND A BIVANE IN THE ATMOSPHERIC SURFACE LAYER. SethuRaman, S.; Brown, R. M. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 13p. (CONF-731205-4). Dep. NTIS $3.00.

From American Chemical Society 2nd joint conference on sensing of environmental pollutants; Washington, District of Columbia, USA (10 Dec 1973).

Two independent systems for determining wind speed and turbulence levels are being used in an on-shore diffusion study on Long Island near Brookhaven National Laboratory. Results obtained from the two instrument systems are compared to illustrate the differences in the measured values of the vector wind, mean wind speed, variance, turbulence level and energy spectra. Details of the physical characteristics and relative advantages of a commercial Vector Vane and a three-dimensional hot-film sensor are also presented. Measurements of the mean wind speed and the turbulence level compared well. The Vector Vane underestimated spectral densities for frequencies above 1 hertz. (auth)

15785 (CEA-N-1659) HOT CELL INSTALLATION FOR A MULTICHANNEL SPECTROMETER USED FOR IN SOLUTION X-RAY FLUORESCENCE ANALYSIS. Sarrat, P.; Denis, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1973. 19p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

A shielded installation for the x-ray fluorescence analysis of highly radioactive samples is presented. This installation, which is shielded by 20 cm of Pb, enables liquid and solid samples to be analyzed. The x-ray assembly is provided with a movable shielded goniometer and fixed channels (maximum of 4 channels). The system for positioning the samples in the shielded well is described. (FR)

15786 (DESY-73-45) DIDO: A MOST VERSATILE PATTERN-UNIT WITH FAST DISCRIMINATOR-INPUTS AND CAMAD-/PERSEUS-OUTPUT FACILITIES. Quehl, H.; Stuckenberg, H.-J.; Brechtel, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

A pattern-unit with fast discriminator inputs, strobed coincidence with resolving time of 5 ns and buffer register with standard CAMAC-readout or the very fast PERSEUS-readout is described. The circuit is fabricated in a 4-fold CAMAC plug-in unit. (auth)

15787 FAST RETRACE OF PARTICLE ORBITS THROUGH A LARGE, INHOMOGENEOUS MAGNETIC FIELD. McKee, R. J. (National Research Council of Canada, Ottawa). Nucl. Instrum. Methods; 114: No. 2, 321-326(1974).

A fast method of retracing orbits through a large, inhomogeneous magnetic field has been developed for applications in particle-physics experiments. The momenta of particles are found by simple linear interpolation in a mesh of previously calculated representative orbits. The essential feature of the scheme is to perform a transformation on the set of observables defining the orbit before doing the interpolation. This is done to reduce both interpolation errors and the required number of mesh points. A detailed development of the method is presented for an actual apparatus. For this apparatus particles were retraced in 0.6 ms/orbit using a CDC 6600 computer, and for 100 mesh points interpolation errors were found to be smaller than experimental errors by more than an order of magnitude. (auth)

15788 EVIDENCE FOR ETHYLENE-MOLECULE CLUSTERS IN A GAS JET SYSTEM. Wiesehahn, W. J. (Simon Fraser Univ., Burnaby, B. C.); D'Auria, J. M.; Irwin, J. C. Nucl. Instrum. Methods; 114: No. 2, 401-404(1974).

The presence of large clusters in the input carrier gas of a gas jet recoil transport system has been established from light-scattering experiments. With a 90° scattering geometry a λ^{-1} dependence was observed for light scattered by flowing ethylene gas, obtained from a reservoir that was maintained above the critical pressure. Estimates of lifetimes, diameter and density of clusters in the flowing gas are provided. (auth)

15789 PULSE SHAPE IN A PARALLEL PLATE ELECTRON MULTIPLIER FREE FROM ION FEEDBACK. Berg, S.; Andersson, L. P. (Uppsala Univ.). Nucl. Instrum. Methods; 114: No. 2, 245-247(1974).

A parallel plate channel electron multiplier has been constructed for single pulses. The pulse properties such as rise time and duration are investigated for this multiplier. (auth)

15790 INFLUENCE OF THE TIME-OF-FLIGHT SPREAD OF PHOTOELECTRONS ON THE MEASUREMENTS OF THE SHAPE OF SUBNANOSECOND LIGHT PULSES IN 8850 RCA PHOTOMULTIPLIERS. Sipp, B.; Miehe, J. A. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods; 114: No. 2, 249-253(1974).

An investigation of the time-of-flight fluctuations of the photoelectrons between the photocathode and the first dynode is carried out by using short light pulses and delayed coincidence techniques. The differences of the transit time of a photoelectron with the position of the light spot on the photocathode are investigated by measuring the single photoelectron time interval distribution. The experimental results (variation of the mean value and variance of the transit time) are consistent with the idea that the time dispersion results from non uniformities in the geometric structure and in the electric field of the cathode—first dynode space. (auth)

15791 EFFECTS OF LATERAL DISPLACEMENT OF THE FRONT EDGES IN A PARALLEL PLATE CHANNEL MULTIPLIER. Andersson, L. P.; Berg, S. (Uppsala Univ.). Nucl. Instrum. Methods; 114: No. 2, 233-236(1974).

The effect of lateral displacement of the two parallel plates on the electron trajectories in a parallel plate channel multiplier are discussed. Electrons travelling from one plate to the other and electrons returning to the same plate are both shown to be present. (auth)

15792 NEUTRON BEAM COLLIMATORS. Lundberg, D. A. (to Elliot Brothers (London) Ltd.). US Patent 3,781,564. 25 Dec 1973. Filed date 28 Feb 1973. 6p.

A neutron beam collimator consisting of a matrix of epoxy resin loaded with particles of tungsten for moderating the neutrons, and with particles of a hydrogenous material for further moderating and capturing the neutrons is described. A layer of lead is provided to attenuate gamma radiation produced during neutron capture. A slow-neutron absorbing material is intimately mixed with the tungsten to reduce collisions between slow neutrons and the tungsten atoms, thereby avoiding induced radioactivity in the tungsten. (Official Gazette)

15793 NEUTRAL PARTICLE BEAM SEPARATOR AND VELOCITY ANALYZER USING RADIATION PRESSURE. Ashkin, A. US Patent 3,778,612. 11 Dec 1973. Filed date 1 Nov 1971. 10p.

In the disclosed neutral-particle molecular-beam or atomic-beam separator, velocity analyzer or synchrotron, it is proposed to use the saturated value of radiation pressure on the particles, illustratively neutral particles, to deflect them in semicircular paths or in circular orbits. A light field at a resonance radiation frequency for the particles is created that converges radially in a horizontal plane throughout the desired portion or arc of a circle with intensity sufficient to exceed the saturated value and thus create a constant central force field. The field of use includes studying the interaction of atoms with high-intensity monochromatic light, and also includes separating, velocity analyzing or trapping neutral atoms having a specific hyperfine level or belonging to a specific isotopic species, such as those useful for nuclear power generation. (Official Gazette)

15794 ION KINETIC ENERGY SPECTROMETRY. Beynon, J. H.; Cooks, R. G. (Purdue Univ., Lafayette, IN). J. Phys., E (London); 7: No. 1, 10-18(Jan 1974).

The principles upon which accurate measurements of kinetic energy of kilovolt ions are based are illustrated, and the design of an instrument for focusing the ions formed by reactions in

a field-free region is described. Measurement of both the kinetic energy and mass-to-charge ratio of an ion formed in a field-free region of a mass spectrometer allows one to define the complete ionic reaction under examination, rather than just the reaction product. Reactions that have been studied include spontaneous decompositions as well as charge-stripping, charge-exchange and charge-inversion both for rare gases and for organic compounds. The results give information on the energies of excited states, on double ionization potentials and on electron affinities. Other ion-molecule reactions involving excitation of organic ions but without charge permutation yield valuable information concerning energy partitioning between excitational and translational forms. Similar studies on metastable ions that fragment unimolecularly have also been used in energy partitioning studies. The width of the associated metastable peak gives a direct measure of the translational energy released in the fragmentation. (auth)

15795 CALIBRATION OF A TIME-OF-FLIGHT MACHINE FOR MOLECULAR BEAM STUDIES. Beijerinck, H. C. W.; Moonen, R. G. J. M.; Verster, N. F. (Technische Hogeschool, Eindhoven, Netherlands). J. Phys., E (London); 7: No. 1, 31-36(Jan 1974).

A time-of-flight machine for the velocity analysis of molecular beams is described together with an experimental investigation of systematic errors. A velocity selecting chopper is used to measure all delay times, including the delay in the beam detector due to the extraction time from the ionizer and the flight time of the ions in the quadrupole mass filter. With this ionizer no memory effects occur at emission currents smaller than 1 mA. Memory effects in the detector chamber due to the direct reflection of beam particles are eliminated by collimating the beam before the entrance and by trapping the beam in a separate volume afterwards, while obstacles inside the detector chamber are carefully avoided. The absolute calibration of the detector gives an efficiency of 1.6×10^{-4} counts/molecule for an O_2 beam of 1000 m s^{-1}. Calibrations a week apart reproduce to within 6%. (auth)

15796 NUCLEAR PHYSICS IN WELDING MATERIALS INSPECTION. Zitnansky, B. (Welding Research Inst., Bratislava). Hutn. Listy; 28: No. 2, 141-143(Feb 1973). (In Czech).

A nuclear installation designed for activation analysis efforts permitting a wide scope of speedy, non-destructive analyses of the chemical composition of materials is described. The advantages of this type of analysis are shown by the determination of fluorine in fluxes. (Nuclear Sci. Abstr. Czech.)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 16111.

15797 (K-1854) KEYWORD INDEX TO UNCLASSIFIED ORGDP FORMAL REPORTS, JULY 1947–SEPTEMBER 1973. Ferguson, J. B.; Fraser, R. J. (comps.). (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 90p. Dep. NTIS $5.45.

A KWIC (Keywords in Context) permuted-title index is presented for all of the formal unclassified K-reports (July 1947 through September 1973) that have contributed significantly to gaseous diffusion technology. An author index and a document number index are also included. These latter two indexes contain complete citations to the original documents. (auth)

15798 (K-L-6332) RAREFIED FLOW AND DIFFUSION OF NEON ISOTOPES. Fain, D. E.; Brown, W. K. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 9 Nov 1973. 13p. (CONF-731129-1). Dep. NTIS $3.00.

From meeting of the fluid dynamics division; New Haven, Connecticut, USA (19 Nov 1973).

A comprehensive study of the variation in the separation efficiency of neon isotopes by gaseous diffusion as a function of pressure with three significantly different types of geometrical flow channels was made. The experimental apparatus for performing the study and some results are described. A large body of data was collected. A complete description of the work is presently in publication. (TFD)

15799 CENTRIFUGAL GAS SEPARATOR WITH ELECTRIC MOTOR DRIVE. Tahara, H.; Sakurai, M.; Yamada, H. (to Tokyo Shibaura Electric Co.). US Patent 3,780,937. 25 Dec 1973. Priority Date 27 Feb 1970, Japan. 6p.

A centrifugal gas separator for uranium isotopes is described which employs a vertically oriented centrifuge drum mounted on suitable bearings within a stationary housing and driven by an electric motor. The electric motor is constructed in annular form with its stator portion fixed to the stationary housing and its rotor portion fixed to the centrifuge drum and positioned generally below its stator portion. When the electric motor is energized, the magnetic attraction between its stator and rotor portions tends to lift the centrifuge drum, thereby reducing the weight supported by the bearings and reducing bearing wear. In addition, elastic or magnetic devices are alternatively provided to dampen the vibration of the rotating centrifuge drum. (Official Gazette)

15800 SEPARATION OF URANIUM ISOTOPE BY PLASMA CENTRIFUGE. Okada, O. (Hitachi Ltd., Tokyo); Dodo, T.; Kavai, T. J. Nucl. Sci. Technol. (Tokyo); 10: No. 10, 626-631 (Oct 1973).

A method of centrifugal separation of isotopes by electromagnetic means is presented. The principle proposed utilizes electromagnetic acceleration by the interaction between an electric current in a slightly ionized gas and an external magnetic field. The analysis shows that an azimuthal flow of 2.6 km/sec can be realized with a magnetic field of 200 gauss and an electric current of 1.5 kA. The resulting centrifugal force is large enough to permit realization of a more compact concentration cascade than the conventional mechanical centrifuge. (auth)

Isotopic Power Sources

Refer also to abstracts 15428, 15439, and 15443.

15801 (GE-TM-65-11-7) ^{244}Cm AND ^{238}Pu CRITICALITY ANALYSIS. Appendix B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). [nd]. Contract AT(40-1)-2847. 13p. Dep. NTIS $3.00.

Declassified 28 Nov 1973.

Because of the projected use of kilogram quantities of ^{244}Cm and ^{238}Pu for isotopic heat sources, a criticality analysis of these materials is presented. (TFD)

15802 (MND-3169-16-A) SNAP 19C-2 SAFETY REPORT. Conway, T. W.; Dobry, T. J. (Martin Marietta Corp., Baltimore, Md. (USA)). Nov 1965. 34p. Dep. NTIS $3.75.

Declassified 28 Nov 1973.

A 20-W thermoelectric generator for a 16-month, unattended, terrestrial mission was developed. The generator uses six ^{238}Pu-fueled capsules as a heat source. A detailed nuclear safety evaluation of the generator on this terrestrial mission is presented. Information is included on safety hazards during handling, transport, and operation at the site; design criteria; SNAP 19C-2 system description; description of Rock Island site in Bering Strait; and radiation hazards. It is concluded that the SNAP 19 C-2 generator can be operated safely under all normal conditions, and that fuel will not be released from the capsule even in the most severe condition, i.e., when the fuel is exposed to a high thermal environment with the generator short circuited. (LCL)

15803 IMPLANTABLE NUCLEAR POWER SOURCES FOR ARTIFICIAL HEARTS: PROGRESS REPORT, TWO YEARS AFTER IMPLANTATION IN THE DOG. Norman, J. C. (Harvard Medical School, Boston); Huffman, F. N.; Molokhia, F. A.; Asimacopoulos, P. J.; Warren, S. Bull. Soc. Int. Chir.; 32: No. 1, 62-74(1973).

Research progress on the development of a totally implantable artificial heart is reported. Three years ago 16- and 24-W ^{238}Pu fuel capsules containing 33 g of 560 Ci and 50 g or 845 Ci of ^{238}Pu (half-life, 89.5 y) with surface temperatures in air of 450 and 560°F, respectively, were implanted in series within the thoracic aortas of dogs. An extended series of physiologic, metabolic, and immunohematologic studies were performed. No major harmful effects were found. Autopsies performed 25 and 26 months after implantation failed to reveal any major abnormalities attributable to prolonged intracorporeal heat or radiation. However, lymphoid depletion of mediastinal nodes and the upper pole of the spleen was noted along with minimal adjacent marrow depletion. There was no evidence of neoplasia. (auth)

Radiation Sources

Refer also to abstracts 15743 and 15772.

15804 (EURISOTOP-72, pp 329-357) POSSIBILITIES OF THE USE OF CALIFORNIUM-252. Mueller, W. (Europaeisches Institut fuer Transurane, Karlsruhe, Ger.). 1973. (In German).

From symposium on nuclear analysis techniques in the production and industrial use of noble metals; Brussels, Belgium (16 Nov 1971).

The properties of ^{252}Cf sources are discussed and compared with the properties of other neutron sources. The preparation of ^{252}Cf sources is described. Examples are given of the use of these sources in the prospection and analysis of noble metal minerals. (JSR)

15805 EMISSION SPECTRA OF Na–D_2O, In–Be, La–Be, AND Na–Be PHOTONEUTRON SOURCES. Mueck, K.; Bensch, F. (Atominstitut der Oesterreichischen Hochschulen, Vienna). J. Nucl. Energy; 27: No. 12, 857-873(Dec 1973).

The energy distributions of the photoneutrons of Na–D_2O, In–Be, La–Be and Na–Be source systems were measured by means of a proton-recoil proportional counting tube. Spherical lead-shields of various thicknesses ranging from 1.5 to 13 cm were used to reduce the intense gamma field accompanying the neutron spectra to be measured. The spectra of spherical heterogeneous source arrangements for Be-target thicknesses of 0.5, 1.1 and 2.0 cm were measured and compared with the theoretical distribution as obtained by Monte Carlo calculations. The change in spectrum shape due to the lead shields was also calculated by a Monte Carlo routine. Good agreement between theoretical predictions and experimental results shows values for the peak of the neutron distribution of 264.1 ± 0.5 keV for the Na–D_2O system, 397.3 ± 0.8 keV for the In–Be system, 761.7 ± 0.7 keV for the La–Be system, and 966.9 ± 0.5 keV for the Na–Be source system. With the La–Be system a second neutron group of much lower intensity, 6.5% of the main group, could be found with a peak energy of 1097.5 ± 1.0 keV in good agreement with recent gamma-spectroscopic measurements. (auth)

Design and Fabrication

Refer also to abstracts 15477 and 15478.

15806 (DP-1320) CALIFORNIUM OXIDE–PALLADIUM CERMET WIRE AS A ^{252}Cf NEUTRON SOURCE FORM. Mosley, W. C.; McBeath, P. E.; Smith, P. K. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jan 1974. Contract AT(07-2)-1. 42p. Dep. NTIS $4.00.

An improved ^{252}Cf neutron source form has been developed to

enhance containment of ^{252}Cf during production of the sources and to lower the sale price of ^{252}Cf sources by commercial encapsulators. Process steps are described for preparing californium oxide-palladium cermet powder by palladium chemical plating, fabrication of cermet pellets by pressing and sintering, fabrication of bare wire by rolling, and adjustment (reduction) of ^{252}Cf linear concentration by roll cladding. ^{252}Cf is distributed uniformly in the wires, which can be made in concentrations suitable for a full range of industrial source strengths (from 1×10^7 to 2.5×10^{10} n/sec). These processes were developed in laboratory tests with stand-ins and ^{252}Cf tracer, and were demonstrated with milligram quantities of ^{252}Cf in the Target Fabrication Facility (TFF). Improved wire forming techniques are being developed to manufacture clad wire on a larger scale. (auth)

15807 PREPARATION OF ^{252}Cf NEUTRON AND FISSION-FRAGMENT SOURCES. Adair, H. L.; Kuehn, P. R. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 114: No. 2, 327-332 (1974).

Several techniques, including electroplating, self-transfer, vacuum evaporation, and drying of stock solutions, are described for preparing ^{252}Cf sources. The advantages and disadvantages of each technique for preparing either fission-fragment or neutron sources are discussed. Fission-fragment energy spectra for typical sources prepared by each technique are shown. (auth)

Industrial Uses

Refer also to abstracts 15233, 15479–15482, 15864–15866, and 15910.

15808 (EURISOTOP-75) RADIATION PRESERVATION OF SHRIMPS. Symposium Held in Ostend, Belgium, April 18–19, 1972. Hovart, P.; Vyncke, W. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1973. 383p. (In Several Languages). (CONF-720484-).

Sixteen papers were presented at the symposium covering economical, technological, and legal aspects of radiopreservation of shrimp. (TFD)

15809 NUCLEAR APPLICATIONS TO TECHNOLOGY. Ljunggren, K. (Isotoptekniska Laboratoriet, Stockholm). (1973). vp.

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

Some recent achievements and present trends in the use of isotopes, particularly in radiometry and tracing, are discussed with reference to process technology in a number of industrial branches. New radiometric methods based on the use of neutron sources, especially intended for on-stream applications, have been and are being developed. Nondispersive x-ray fluorescence techniques with isotope sources have been considerably improved both for on- and off-stream applications. The development has been made possible partly by the use of new semiconductor detector systems. Tracer methods have been developed as a very efficient tool for diagnosing continuous production processes with respect to transport and conversion dynamics, which has led to a very fruitful exchange with automation and control engineering, particularly in the chemical process industry and allied industries. New theoretical achievements in the interpretation of residence time distribution which also permit analysis of recycled flow, encountered in closed-loop systems, are reported. With the increasing demands for waste water treatment, a renewed interest has been devoted to tracer investigations of treatment plants. The unique possibility of labelling sludge with radioactive γ-emitting tracers for in-situ measurements of sludge flow has been studied. (GE)

15810 RADIOINDUCED CHANGES IN RESPIRATION, ORGANOLEPTIC PROPERTIES, WEIGHT, FLESH FIRMNESS, AND SURFACE COLOR OF APPLE FRUITS DURING CONTROLLED ATMOSPHERE (CA) STORAGE. Okamoto, T.; Harata, J.; Osanai, T. (Hirosaki Univ., Aomori, Japan). Hirosaki Daigaku Nogakubu Gakujutsu Hokoku; No. 18, 1-6(Mar 1972).

Jonathan apples were irradiated with ^{60}Co gamma rays, with doses of 0 (control), 5, 50 and 200 Krad (dose rate: 100 Krad/hr), stored for 6.0 months in a CA room (oxygen 3%, carbon dioxide 3%) at 0°C and analyzed. No significant differences between irradiated and unirradiated apples in changes of weight, flesh firmness, and surface color, were shown until 6.0 months storage under CA conditions at 0°C. The irradiation of apple fruits with a dose of 200 Krad lowered their qualities in respect to respiration and organoleptic properties. Apples irradiated with a dose of 5 Krad, however, showed the lowest respiration rate and kept superior qualities which were evaluated by organoleptic tests. According to the above results, the irradiation with 5 Krad may be recommended as the pretreatment of CA storage of apple fruits. (auth)

15811 DETERMINING THE LOCATION OF VERTICAL CHANNELS IN A WELLBORE. Hayes, D. A. (to Schlumberger Technology Corp.). US Patent 3,784,828. 8 Jan 1974. Filed Date 25 Mar 1971. 10p.

An illustrative embodiment of the invention shows a radioactive tracer technique for distinguishing vertically flowing liquids in formation fractures from flows through passageways in the cement annulus between the steel casing and the borehole wall. Typically, two radiation detectors of different sensitivities respond to a radioactive tracer that has been discharged into the formation at the well depth of interest. If the tracer material moves in a vertical direction with respect to the injection depth, relatively high count rates from both of the detectors indicate that the tracer is flowing vertically through a fracture in the cement. A relatively low count rate in the less sensitive detector, however, indicates that the vertical flow is taking place away from the casing and at some depth within the formation. (Official Gazette)

15812 DETERMINATION OF THE EFFECT OF DIFFERENT ATMOSPHERIC COMPOSITION ON THE QUALITY OF COLD STORED IRRADIATED APPLES. Okamoto, T.; Harata, J.; Osanai, T. (Hirosaki Univ., Aomori, Japan). Hirosaki Daigaku Nogakubu Gakujutsu Hokoku; No. 18, 7-21(Mar 1972).

Jonathan apples were irradiated with ^{60}Co gamma rays, in doses of 0 (control), 2.5, 5, 7.5, 10, 50, 100 krad (dose rate: 20 krad/hr), and 50 krad (dose rate: 100 krad/hr), and stored at 0°C in three controlled atmosphere rooms (oxygen 3 to 5%, carbon dioxide below 0.5%; oxygen 21%, carbon dioxide 2 to 2.5%; oxygen 3 to 5%, carbon dioxide 2 to 2.5%) and in a common refrigerated room for 4.5 months. Irradiation of apples with doses of 10 krad or more seemed to lower slightly their qualities and the same tendency was observed in CA apples. Generally, the effects of CA storage, especially in 3 to 5% O_2 and 2 to 2.5% CO_2, on the qualities of apples, i.e., respiration, organoleptic properties, changes in weight, surface color, were stronger than the irradiation effect. However, it seems to be true that the treatment with doses of about 5 krad is not at all inferior to the other treatment. So, as the pretreatment of CA storage of apples the irradiation dose of about 5 krad may be recommended. (auth)

15813 ELECTRON BEAM CURING OF SURFACE COATINGS. Verdin, D. (Atomic Energy Research Establishment, Harwell, Eng.). Rep. Progr. Appl. Chem.; 57: 687-691(1972).

The use of high energy electron beams to initiate polymerization reactions in surface coating resins has arisen from the availability of electron accelerators operating in the region around 300 kV and delivering continuous beam currents up to 100 mA, and, consequently, giving dose rates of the order of 50 Mrad/s in paint films up to about 400 μm thick. A brief review is presented of recent progress in this field. (UK)

15814 UTILIZATION OF ^{252}Cf IN RADIOMETRY. Brana-Zugravescu, A. Stud. Cercet. Geol., Geofiz., Geogr., Ser. Geofiz.; 10: No. 2, 275-279(1972). (In French).

The neutron activity of ^{252}Cf facilitates a positive determination of numerous low-concentration elements in rocks. With its help oil, gas and water accumulations, and mineral deposits located on the bottom of seas can be detected. The neutron activation method using ^{252}Cf has a clear superiority as compared with activation with other isotopic sources, due to the particular properties of this radioisotope. (Rom. Sci. Abstr.)

15815 IDENTIFICATION OF IRRADIATED MUSHROOMS. Muenzner, R. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). (1973). vp. (In German).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

A very simple method is described using a 2,3,5-triphenyltetrazolium chloride solution as an indicator. The experiments have shown that only non-irradiated mushrooms could reduce the indicator solution to the red triphenylformazane. In the case of irradiated mushrooms, the solution retains its brown color. (GE)

15816 OBJECTIVES AND PRESENT STATUS OF IRRADIATION OF FISH AND SEAFOODS. Hannesson, G. (Icelandic Fisheries Labs., Reykjavik). Food Irradiat. Inform.; No. 1, 28-64(1972).

From FAO/IAEA study group meeting on food irradiation for the South East and East Asian countries; Bangkok, Thailand (13 Dec 1971).

The present state and possible commercial uses of radiation for the preservation of fish and fishery products are reviewed. Discussing the objectives of food preservation by ionizing radiation in general, the concepts of radappertization, radicidation and radurization, and the application of these methods for the preservation of fish in particular are discussed. As it has been observed that the irradiation of many species of fish and seafoods with doses above

0.3 to 0.5 Mrad produces discoloration and undesirable off-flavors and off-odors, an outline is given of attempts to overcome these defects, e.g., by using heat treatment prior to irradiation, or low temperatures during irradiation. Special attention is given to microbiological problems, such as the elimination of pathogenic bacteria (Salmonella, Vibrio parahaemolyticus, Bacillus spp.) and toxigenic bacteria such as Clostridium botulinum, considering particularly type E of this bacterium and its spores as this type has a widespread geographic distribution in fish. The test methods applied to assess the quality of irradiated fish, namely sensory tests, chemical tests, and microbial tests, are mentioned, followed by an outline of the technology of radurized marine products, discussing such influencing factors as storage temperatures and packaging, as well as of public health control and the commercial prospects of fish irradiation in Europe, North America, and in developing countries. (GE)

15817 CYTOTOXICITY AND MUTAGENICITY OF IRRADIATED FOODS. Moutschen, J. (Univ., Leige). Food Irradiat. Inform.; No. 2, 51-64(Sep 1973). (In French).

Problems related to the increase of potential risks of irradiated foods from the standpoint of cytotoxicity and mutagenicity are reviewed. The following methods for evaluating the cytotoxic and mutagenic effects of irradiated food are discussed; tests for detecting biochemical mutants in microorganisms and cultured mammalian cells; detection of chromosome aberrations or cellular lesions in higher organisms, chiefly mammals; and tests for revealing mutagenic effects on the entire organism. The qualities of a good test include the possibility of extrapolating the results to man and obtaining a large enough sample for statistical evaluation. Results of research on the following foods are reported: fruit juices, fruits, potatoes, dried milk, wheat flour, meats, and vegetables. It is concluded that neither mutagenic nor other effects could be attributed to radiation. (HLW)

15818 PREVENTION OF DETERIORATION OF POTATOES UPON STORAGE. Food Irradiat. Inform.; No. 2, 43-49(Sep 1973).

The effectiveness of maleic hydrazide, chlorolsopropylcarbamate and other chemicals for inhibition of sprouting in potatoes is discussed. Sprout inhibition by irradiation is discussed with regard to: effects of radiation on ability of tubers to form wound periderm; effective radiation dose levels; and effects of radiation on respiration and content of sugars and ascorbic acid. In regard to wholesomeness of treated potatoes, residues caused by chemical sprout inhibitors and effects of radiation on vitamin and starch content are considered. Long-term feeding studies in rats, mice, and monkeys were conducted in Japan. A discussion is given of steps toward commercialization of irradiated potatoes in Hungary, Germany, Canada, the USSR, and Japan. (HLW)

15819 PROGRESS AND FUTURE TASKS IN FOOD IRRADIATION. Food Irradiat. Inform.; No. 2, 10-19(Sep 1973).

Progress in the use of atomic energy for preserving food was reviewed at recent meetings of the Second International Symposium on Food Irradiation in India. The technical feasibility of radiation control was discussed with regard to the inhibition of sprouting in yams by gamma radiation; combined radiation and chemical treatment of potatoes and onions to prevent sprouting; effects of radiation on starch preparations and seasonings; radiation preservation of fish; radiation effects on bacteria; and control of insect pests. The importance of assessing the economic feasibility on the basis of practical, large-scale tests is emphasized. With regard to wholesomeness, reports were given of acute and chronic toxicity tests with irradiated wheat, shrimp, whole diets, beef, strawberries, mushrooms, and chicken. No harmful effects were observed following large-scale animal testing of irradiated complete diets. A summary of tasks ahead includes an assessment of economic benefits of food irradiation; criteria of public health acceptance; education of the public; and international collaboration with the FAO and IAEA. (HLW)

15820 IRRADIATION OF DRIED FOODSTUFFS. Saint-Lebe, L. (Dept. of Biology, Saint-Paul-Les-Durance, France). Food Irradiat. Inform.; No. 1, 23-27(1972). (In French).

A discussion is presented of the increasing use of dried foodstuffs (such as instant soups and coffee) and of the problems arising in connection with the preservation of such food, as it may contain such pathogenic and toxigenic microorganisms as Aspergillus flavus, Aspergillus clavatus, and Penicillium citrinum which must be removed by appropriate preservation methods. Food irradiation seems to be a promising treatment for this purpose and the author briefly discusses the various methods currently feasible and compares them with the conventional preservation techniques by means of chemical agents which very often prove to be detrimental to health. The technological as well as the legal problems involved are discussed. (GE)

15821 RADIOPHARMACEUTICALS REQUIRE SPECIAL CONTROLS. Bowen, B. M.; Stewart, D. J.; Wood, D. E. (Univ. of Toronto). Hospitals; 45: 88-98(1 Oct 1971).

The temporary loss of a large quantity of radioactive material at Toronto General Hospital instigated a careful review of the hospital's method of handling radiopharmaceuticals. As a result of this review, a new unit designated the radiopharmacy was developed jointly by the department of pharmaceutical services and the division of nuclear medicine. Three model radiopharmacies (based on the type of hospital) are discussed. (LK)

15822 NUTRITIONAL HYGIENE ASPECTS OF RADIOPRESERVATION OF FOOD. Uralova, M.; Grunt, J. (Vyskummy Ustav Hygieny, Bratislava). Cesk. Hyg.; 18: No. 3, 119-126(Apr 1973). (In Slovak).

The determination of the optimum regimen of irradiation for the preservation of vitamin E in possible use of ionizing radiation for pasteurization and sterilization is very important from the point of view of hygiene. Various experimental examinations confirmed the destructive effect of ionizing radiation (γ rays) on vitamin E. The radioresistance of vitamin E is dependent on the concentration of the preparation in a solution. Increasing the dose of ionizing radiation was found to result in an increasing percentage of destruction; the input of the source of radiation also proved to be important. The study into the effect of storage time on the content of vitamin E in irradiated samples revealed that radiolytic processes were going on not only during the actual irradiation but a long time after the irradiation. (INIS)

15823 POTENTIALS OF IONIZING RADIATION FOR FOOD PRESERVATION. Goresline, H. E. Food Irradiat. Inform.; No. 2, 20-34(Sep 1973).

A general discussion of radiopreservation of foods is given. Besides a limited amount of technical data, the potential usefulness of the method is pointed out. (TFD)

15824 RADIOSTERILIZATION OF DRUGS. Blazek, J. Pharmazie; 28: No. 5, 339-340(May 1973). (In German).

After ^{60}Co irradiation, both the sterility of camomile and the camomile content of volatile oil were studied. Since spore-bearing organisms survive exposure to lower doses, the radiation dose has to be at least 3 Mrad to achieve complete sterilization. At 3 Mrad, the moisture content played no significant role. Irradiation did neither affect significantly the content of volatile oil nor the composition of the oil. (HBG)

15825 INFLUENCE OF FOOD PROCESSING ON MIREX. Lane, R. H. Baton Rouge, LA; Louisiana State Univ. (1973). 91p. University Microfilms Order No. 73-27,849.

Thesis (Ph.D.).

Recently, food processing has been suggested as a method of degradation for pesticide residues in foods. Tissue samples and eggs contaminated with Mirex, an organochlorine, were obtained from crawfish and Mallard Ducks previously exposed to fire and bait containing Mirex (0.3% technical material). Crawfish were subjected to a commercial thermal processing procedure (121°C, 15 psig, 13 min). Eggs as well as crawfish were subjected to a more drastic heat treatment (124°C, 18 psig) for 2 and 6 hours, respectively. Analysis of variance of Mirex residues in control and processed samples indicated no significant difference in the means of controls or processed samples. The irradiation of crawfish tissues containing Mirex residues with ultraviolet light for 12 and 24 hours showed no significant difference in the means of controls or treated samples. Photolysis and gamma irradiation of eggs, however, demonstrated a highly significant difference among the mean Mirex residue content of controls and the means at various time intervals as irradiation proceeded. Appropriate orthogonal comparisons from both uv and gamma radiation treatments indicated a linear relationship between Mirex degradation and increasing radiation dosage. Mirex degradation and new product formation were monitored by electron capture gas chromatography. New products, monohydro and dihydro derivatives of Mirex, were separated and identified by combined flame ionization gas chromatography-mass spectrometry as well as retention time data. Eight uv and gamma irradiation products were detected of which four were assigned tentative structures. A monohydro derivative obtained from gamma irradiation only was positively identified by comparison of its mass spectrum and retention time with that of an authentic sample. (Diss. Abstr. Int., B)

15826 KRYPTON-85 IRRADIATION FACILITIES FOR CHEMICAL REACTION. Ootsuka, N.; Yamamoto, T. (Japan Atomic Energy Research Inst., Takasaki). Nippon Genshiryoku Gakkai-shi; 15: No. 10, 681-692(Oct 1973). (In Japanese).

Irradiation facilities using ^{85}Kr as radiation source have been devised for producing chemical reactions in liquid phase. For this purpose, the ^{85}Kr gas is dispersed uniformly in the liquid phase

containing the reactants, so that the ^{85}Kr gas and the reactants come into direct contact with each other. A description of such a facility is presented, together with its performance, and the technical problems encountered in the designing and manufacturing stages (particularly, for the prevention of ^{85}Kr gas leakage, and for the removal and recovery of ^{85}Kr gas dissolved in the liquid reactants). Safety considerations are also discussed. Some typical experimental results are reported. Irradiation experiments were performed in a reaction vessel of 1l capacity charged with 300 Ci of ^{85}Kr. It was observed that the maximum dose rate reached 1.8×10^4 rad/hr, and that the radioactive concentration after removal of the ^{85}Kr gas dissolved in the solution diminishes to a level below 10^{-5} μCi/g. From these results, it is concluded that it should be quite practical to use ^{85}Kr as a radiation source for chemical reactions in the liquid phase. (auth)

15827 EFFECT OF GAMMA-IRRADIATION ON THE STORAGE STABILITY AND QUALITY OF POLISHED WHEAT. Lee, S. R.; Kim, S. K.; Lee, K. Y. Han'guk Sikp'um Kwahakhoe Chi; 5: No. 2, 95-100(1973).

In order to study the effect of gamma rays on the storage stability and quality of polished wheat, the grain was irradiated at 50 to 1000 krad levels and quality assessment was made for three-month storage period. The results are summarized as follows: growth of molds was apparent at equilibrium moisture content above 14.8% of the grain, but their growth was retarded at 250 krad level; irradiation at 250 krad level had no adverse effect on fat acidity, reducing sugar content, and color of the grain; irradiation of the grain caused the increase of degree of gelatinization and the decrease of viscosity; and irradiation at 250 krad level brought about higher digestibility of the grain. (Korean Sci. Abstr.)

15828 PROGRESS IN IRRADIATION. Food Eng. (Philadelphia); 80-81(Jul 1973).

A brief review of the Second International Symposium on Food Irradiation, Bombay, India is presented. New uses and techniques are pointed out. Clearances for human consumption of irradiated foods obtained around the world are given. (TFD)

15829 ASSESSMENT OF SUITABILITY OF FLEXIBLE PACKAGING MATERIALS FOR PACKAGING OF IRRADIATED FOODS. Agarwal, S. R.; Kumta, U. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). J. Food Sci. Technol. (India); 9: No. 4, 166-170(Dec 1972).

Polyethylene films (0.076 to 0.165 mm) as well as laminates of polyethylene with paper or cellophane or aluminium/polyethylene/paper were found to be impermeable to bacteria. Aluminium laminate gave zero permeability to water vapour at 37°C and 80% RH whereas other materials showed considerable variations. Comparatively, laminate of polyethylene/cellophane showed lower gas transmission rates than others. The optimum heat sealing temperature or voltage of impulse sealing increased with the increase of thickness of the materials. Some of the applications of these materials for packaging of different types of irradiated foods are discussed. (auth)

15830 COMMERCIALIZATION OF IRRADIATED POTATOES: WITH REGARD TO THE AUTHORIZATIONS DELIVERED IN FRANCE. Pomarola, M.; Sandret, F. Food Irradiat. Inform.; No. 2, 35-42(Sep 1973). (In French).

The principal regulatory arrangements concerning commercialization of irradiated potatoes are considered. Among the specifications given for protection of the consumer against fraud are the following: the irradiated tubers should have normal characteristics and should not receive preliminary chemical treatments; the radiation source should be ^{60}Co or ^{137}Cs administered in doses between 7.5 and 15 rads; packaging regulations; and regulations for potatoes from foreign countries. Studies and tasks preceding the release of the authorization are discussed. The order of authorization should be made by the Minister of Agriculture, the Minister of Economics and Finances, and the Minister of Public Health and Social Security after consultation with the Interministerial Commission of Artificial Radioisotopes, the Council of Public Health, and the National Academy of Medicine. Research on the wholesomeness and physical and chemical characteristics of irradiated potatoes is discussed. Future prospects of the commercialization of irradiated potatoes are considered. (HLW)

15831 PRESERVATION OF PORK SAUSAGE BY GAMMA RADIATION. III. Effects of Heating and Gamma Radiation on the Stability of Amaranth and Tartrazin. Kim, Y. J.; Kong, U. Y.; Kwon, J. C. Han'guk Sikp'um Kwahakhoe Chi; 5: No. 2, 89-94(1973).

Discoloration by heating and gamma radiation of aqueous solutions of two coal-tar food dyes used in meat products was observed. Tartrazin with sodium tri-polyphosphate or cinnamon oil was slightly discolored by heating at 75°C, but Amaranth was comparatively resistant. The effect of gamma radiation on coal-tar food dyes was generally increased with irradiation doses, and especially by the addition of sodium tri-polyphosphate and cinnamon oil. This tendency was higher in Tartrazin than Amaranth. The addition of sodium nitrate and ascorbic acid, and storage at low temperature, however, seems to be effective in decreasing the discoloration of irradiated solutions. (Korean Sci. Abstr.)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 15392, 15822, 15848, 15849, 15876, 15877, 15992, and 16018.

15832 EFFECT OF γ ^{60}Co IRRADIATION ON SOME PROPERTIES OF CATALASE. Bachman, S.; Gasyna, Z. (Inst. of Technical Radiology, Lodz, Poland). Nukleonika; 18: No. 8, 369-374(1973). (In Polish).

Fractions of different molecular weight were found in catalase irradiated in solid state. In the unirradiated and irradiated enzyme preparations the active high molecular weight (500,000) fraction was separated by gel filtration. The changes in the EPR spectra were examined in the samples irradiated at different temperatures. (auth)

15833 INFLUENCE OF CYSTEAMINE ON INTRAMOLECULAR ENERGY TRANSFER IN 5-BROMOURACIL-SUBSTITUTED PHAGE-DNA. Moenkehaus, F. (Univ., Muenster, Ger.). Int. J. Radiat. Biol.; 24: No. 5, 517-524(Nov 1973).

With the aid of an analytical ultracentrifuge, single-and double-strand breakage rates of 5-bromouracil (BrU)-substituted DNA of a defective B. subtilis phage (PBSH) were determined after irradiation with uv (302 to 313 nm) in the presence and absence of cysteamine. The presence of cysteamine reduced the appearance of single-strand breaks (10%) in the BrU-containing strands of hybrid and bifilarly-substituted DNA. The primary breaks lead to secondary breaks in the complementary thymine-containing strand of hybrid DNA or in the complementary BrU-containing strand of bifilarly-substituted DNA (intramolecular energy transfer). Cysteamine strongly reduced (<1%) these secondary breaks, and it is suggested that this indicates that radical reactions are involved in the mechanism of intramolecular energy transfer. (auth)

15834 INCREASED EPIDERMAL DEOXYRIBONUCLEASE I ACTIVITY IN β-IRRADIATED GUINEA PIG SKIN. Irradiation Through the Hair, a Required Control. Tabachnik, J.; La Badie, J. H. (Albert Einstein Medical Center, Philadelphia). Arch. Dermatol. Forsch.; 247: No. 1, 65-71(1973).

Within 24 h after close clipping of guinea pig hair there is dramatic increase in epidermal deoxyribonuclease I (DNase I) and the enzyme can be washed from the skin surface with 0.14 M NaCl or from excised epidermis prior to homogenization. In order to study changes in DNase I activity as a result of β-irradiation injury it was necessary to irradiate through the hair of one flank with 4,700 rep β (^{90}Sr-^{90}Y). These changes were compared with those after a contact dose of 3,000 rep β given to the closely clipped skin surface on the other flank. Extracellular epidermal DNase I increased significantly on days 10 and 15 post-irradiation in both flanks; however, there was a 3 to 4-fold greater concentration on the flank from which the hair had been clipped prior to irradiation. The possible mechanisms for the increase in epidermal DNase I were discussed. (auth)

15835 EFFECT OF FAST ELECTRONS WITH DIFFERENT ENERGY SPECTRA ON TWO DNA FRACTIONS OF MERISTEMATIC CELLS. Elmshaeuser, H. J.; Markus, B. (Univ., Goettingen, Ger.). Biophysik; 10: No. 2, 157-162(1973). (In German).

In previous observations of the frequency of chromosome aberrations in anaphase cell of Allium cepa irradiated with fast electrons in different depths, the varying radiosensitivity in different stages of the cell cycle could be interpreted by assuming a different effect in euchromatin and heterochromatin synthesized at different times. In the experiments described here, two DNA fractions of different molecular weight extracted from the same object and from Vicia faba and defined as euchromatin and heterochromatin by the uptake of ^{3}H-actinomycin D were irradiated under the same conditions. The change in uv absorption after surface and depth irradiation was different for the two chromatin fractions and can be explained in accordance with the chromosome aberrations by repair of euchromatin but not of heterochromatin 9 h after irradiation. (auth)

15836 ROLE OF THE TRYPTOPHAN FLUORESCENT STATE IN THE ULTRAVIOLET-INDUCED INACTIVATION OF β-TRYPSIN. Sellers, D. R.; Ghiron, C. A. (Univ. of Missouri, Columbia). Photochem. Photobiol.; 18: No. 5, 393-402(Nov 1973).

Stern-Volmer quenching constants for β-trypsin at pH 3 were determined for fluorescence quenching by histidine, acrylamide, and nitrate ion. A modified Stern-Volmer plot [Lehrer, Biochem, 10,3254, (1971)] was employed to show that all of the fluorescent tryptophanyl residues of β-trypsin were equally susceptible to quenching by acrylamide at pH 3 when the enzyme was either in its native conformation or denatured in 6M guanidine hydrochloride (GuHCl). Fluorescence lifetime measurements indicated that acrylamide quenched β-trypsin fluorescence by a purely collisional mechanism. Solvation of tryptophanyl residues of the protein was maximal at 2.5 M GuHCl, as monitored by fluorescence emission wavelength. Investigations of the ultraviolet-induced inactivation of β-trypsin at 295 nm were performed in the presence of acrylamide at pH 3. The quantum yields for enzyme inactivation and indole destruction (determined using the PDAB reagent) were unchanged upon depopulation of the fluorescent state by 65%, whether the enzyme was in its native conformation or denatured by 6M GuHCl. It is concluded that the fluorescent state of tryptophanyl residues of β-trypsin is not involved in enzyme inactivation or tryptophan destruction. (auth)

15837 BINDING OF RADIATION-INDUCED AGGREGATES OF LACTATE DEHYDROGENASE. Niemczyk, P.; Schuessler, H. (Univ., Erlangen-Nuernberg, Erlangen, Ger.). (1973). vp.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

In irradiated aqueous solutions of lactate dehydrogenase, formation of aggregates was observed, which was found to be dependent on the radiation dose and the enzyme and saline concentration in the solution. The type of intermolecular binding was studied in these aggregates isolated by gel filtration. Neither the effect of high saline concentrations nor the reduction of the S-S bridges produced by radiolysis will lead to a disconnection of the aggregates. A low concentration ratio of sodium dodecylsulfate (SDS) to lactate hydrogenase with simultaneous reduction also showed no detectable changes in the aggregates in the gel chromatogram. Only a high concentration of SDS which prevents both hydrophobic and electrostatic interactions proved to be successful in disconnecting the bindings in the aggregate. The molecular weight of all the molecular fragments thus obtained is below that of the subunit of the lactate dehydrogenase. (GE)

15838 FORMATION OF SULPHYDRYL PEPTIDES OF LOW MOLECULAR WEIGHT IN HeLa CELLS AFTER IRRADIATION. Archer, J. F.; Wills, E. D. (Saint Bartholomew's Hospital, London). Int. J. Radiat. Biol.; 24: No. 5, 525-531(Nov 1973).

PCMBS (p-chloromercuric-phenyl sulphonic acid), labeled with ^{203}Hg, was used to determine -SH containing peptides formed after irradiation of HeLa cells. Sulphydryl groups of peptides bind firmly and specifically with PCMBS and the labeled compound bound to the -SH containing cell components was separated from unbound PCMBS on the basis of molecular size by Sephadex chromatography. Comparison of control and irradiated cell components showed very few qualitative differences, but significant quantitative differences were observed in the amino acid composition of the low-molecular-weight components separated on the G25 column. Very large increases in aspartic and glutamic acids, threonine, serine, and alanine were observed after irradiation. Studies of -SH components separated by G100 Sephadex showed that a redistribution of -SH had occurred after irradiation and that components formed were probably smaller than 5000 in m.w. The use of G25 columns demonstrated that most -SH components had a molecular weight within range of a few hundred, probably 100 to 400. G10 column fractionations confirmed the existence of small di- or tripeptides in addition to cysteine itself. (UK)

15839 SENSITIZATION OF THE RADIOLYTIC INACTIVATION OF RIBONUCLEASE BY CUPRIC IONS. Bisby, R. H.; Cundall, R. B. (Univ. of Nottingham, Eng.). Int. J. Radiat. Biol.; 24: No. 6, 561-567(Dec 1973).

The effect of complexed cupric ions on the radioinduced inactivation of ribonuclease in nitrous oxide saturated solutions was studied. The effect of pH on the Cu^{2+}/RNase ratio required for the maximum degree of sensitized showed that more sites for binding became involved at higher pH. It is suggested that the variation of the inactivation efficiency with pH was due to histidine residues being involved in cupric binding to ribonuclease. At pH greater than 10, sensitization occurred through hydroxyl radical reaction with thyrosine residues, as was shown by the effect of the selective $(CNS)_2$-radical. Enzymatic inactivation involved formation of the Cu(III) state which oxidized an essential histidine residue. Oxygen and hydrated electrons exerted a protective effect on the cupric ion sensitized inactivation. (auth)

15840 RADIOSENSITIZATION OF PHOSPHATE RELEASE FROM 3'- AND 5'-NUCLEOTIDES: CORRELATIONS BETWEEN

CHEMICAL CHANGE AND BIOLOGICAL INACTIVATION. Raleigh, J. A.; Greenstock, C. L.; Whitehouse, R.; Kremers, W. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Int. J. Radiat. Biol.; 24: No. 6, 595-603(Dec 1973).

The effect of nitrobenzene radiosensitizers on the release of inorganic phosphate in aqueous solutions of 3'- and 5'-nucleotides in the absence of oxygen was quite specific. The 5'-purine nucleotides were sensitized, whereas both 3'- purine and -pyrimidine nucleotides were protected. Sensitization and protection increased with increasing nitrobenzene electron affinity and concentration. The 5'-pyrimidine nucleotides could be protected or sensitized, depending on sensitizer electron affinity and concentration. Correlations between enhancement ratios for chemical and biological damage (Chinese-hamster cell killing in hypoxia) are examined, with a view to relating radiation chemical change in cellular molecules to biological inactivation. (auth)

Radiation Effects on Cells

Refer also to abstracts 15838, 15840, 15958, 15993, 16016, 16017, 16028, 17985, and 17986.

15841 (COO-1632-35) MECHANISMS OF IMMUOSUPPRESSION AND CELLULAR MECHANISMS OF SECONDARY DISEASE. Final Report, September 1, 1971 - August 31, 1973. Uyeki, E. M. (Kansas Univ., Kansas City (USA). Medical Center). 1973. Contract AT(11-1)-1632. 6p. Dep. NTIS $3.00.

The development of antibody-producing cells was studied in vivo and in vitro using radiation, anti-tumor drugs, and antibiotics. The mechanism of action of phenothiazines was studied at the cellular level using a cell separation technique. The effects of puromycin and purine antimetabolites on the various development stages of cells were studied. (HLW)

15842 INACTIVATION OF MAMMALIAN CELLS AFTER DISINTEGRATIONS OF ^{3}H OR ^{125}I IN CELL DNA AT -196°C. Burki, H. J. (Univ. of California, Berkeley); Roots, R.; Feinendegen, L. E. Int. J. Radiat. Biol.; 24: No. 4, 363-375(Oct 1973).

Chinese hamster cells, strain V79-S171, or mouse leukemic cells, strain L5178Y, were permitted to incorporate either ^{3}H-IUdR, ^{3}H-TdR, or ^{125}IUdR, into cell DNA so that the DNA was unifilarly labeled. The cells were then frozen and stored at -196°C to accumulate damage due to isotope disintegration. At various times, cell samples were thawed out and colony-forming ability was measured. Tritium disintegrations in the DNA of Chinese hamster cells were found to be less efficient ($\alpha_0 = 1/970, D_q = 1500$ disintegrations) than the same number of disintegrations in the DNA of mouse leukemic cells ($\alpha_{3T} = 1/306 - 1/175$). This difference was similar to the difference in radiosensitivity seen when the two cell-lines were exposed in the frozen state to external radiation in the form of x or gamma rays. This result is contrasted with the killing efficiencies of ^{125}I disintegrations, which were almost identical in the two cell-lines (L5178Y cells $\alpha_{3T} = 1/46$; V79 cells $\alpha_0 = 1/39$). An analysis of the data suggests that the damage formed when ^{125}I decays within the DNA is inefficiently repaired or not repaired and may involve events specifically associated with the Auger effect, including molecular disruption and possible effects analogous to those seen after high-LET radiation exposure. (auth)

15843 GROWTH AND RADIATION SURVIVAL CHARACTERISTICS OF V79-171b CHINESE HAMSTER CELLS: A POSSIBLE INFLUENCE OF INTERCELLULAR CONTACT. Durand, R. E.; Sutherland, R. M. (Ontario Cancer Treatment and Research Foundation, London). Radiat. Res.; 56: No. 3, 513-527(Dec 1973).

Various aspects of growth and radiation survival characteristics of the V79-171b Chinese hamster cell line were studied during conventional growth on petri dishes. As cells aged after subculture, the cell cycle elongated progressively due primarily to the lengthening of G_1 phase. Plateau phase cultures were partially synchronous in a G_1-like stage of the cell cycle, but had a radiation survival curve characterized by an extrapolation number 15- to 20-fold higher than that of early G_1 phase cells from exponential cultures, and 3- to 4-fold larger than that of asynchronous, exponentially growing cells. No variations in radiosensitivity (D_0) were observed. The similarity of these results to those obtained when this cell line was grown under conditions of extensive intercellular contact as multicellular spheroids suggested that intercellular contact may have been responsible for the enhanced survival observed. Despite this enhanced capacity for accumulation of sublethal radiation damage, the relative ability of plateau phase cells to repair sublethal damage was not significantly larger than that of exponentially growing cells. Potentially lethal radiation damage was not additionally repaired under numerous suboptimal growth conditions studied. (auth)

15844 RADIORESISTANCE OF ANOXIC CELLS AND THE EFFECTS OF PNAP ON THE RADIATION RESPONSE OF AN IN VITRO TUMOR MODEL. Hetzel, F. W.; Kruuv, J.; Frey, H. E.; Koch, C. J. (Univ. of Waterloo, Ont.). Radiat. Res.; 56: No. 3, 460-473(Dec 1973).

Para-nitroacetophenone (PNAP) selectively sensitizes hypoxic mammalian cells to ionizing radiation. The growth of Chinese hamster V79 cells as multicellular spheroids provides a convenient tumor model to test this drug. When irradiated, cells from these spheroids exhibit a multicomponent survival curve. The resistant portion of the curve is primarily due to hypoxic, noncycling cells near the center of the spheroid. However, radiation survival data indicate that these cells are as resistant as the most resistant cycling cells when the latter are made hypoxic. Addition of 500 μM PNAP prior to and during irradiation under oxic conditions decreases the survival on the resistant portion of the spheroid survival curve although the dose-modification is not as large as in hypoxic, monolayer systems. The analog, m-nitroacetophenone, acts in a similar fashion in spheroids. (auth)

15845 ULTRAVIOLET-INDUCED REPAIR REPLICATION IN AGING DIPLOID HUMAN CELLS (WI-38). Painter, R. B.; Clarkson, J. M.; Young, B. R. (Univ. of California, San Francisco). Radiat. Res.; 56: No. 3, 560-564(Dec 1973).

Repair replication was measured after uv-irradiation of WI-38 cells at different passage numbers. A reduced level of DNA synthesis was found only at the last passage before cessation of cell division. This reduction was not evident two passages before this and we conclude that excision repair deficiency is not the basis for in vitro aging of diploid human cells. (auth)

15846 EFFECT OF DIFFERING NEUTRON ENERGIES ON MUTAGENESIS IN CULTURED CHINESE HAMSTER CELLS. Richold, M.; Holt, P. D. (United Kingdom Atomic Energy Authority, Harwell, Eng.). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

Using Chinese hamster cells, strain V79-4, the effects of a range of neutron energies on cell survival and cell mutation were examined. The mutation assay used was that of resistance to high levels of the purine analogue 8-azaguanine. ^{60}Co gamma radiation was used as a reference in these studies. Relative Biological Efficiency (RBE) values for cell survival and cell mutation are presented for 15 MeV neutrons, and for three broad neutron spectra, with energies extending up to 6, 9, and 15 MeV respectively, obtained from deuterons on beryllium. The relevance of these studies to radiological protection norms is discussed. (GE)

15847 PHYSIOLOGICAL AND SPECTROPHOTOMETRIC ANALYSIS OF IRRADIATED TISSUE CULTURE CELLS. Thiessen, G. Stuttgart; Fischer (1972). 101p. (In German).

According to the opinion of the author, investigations in radiobiology should nowadays not be restricted to the study and determination of radiation damages as a consequence of complex reactions, but rather be carried out in order to determine and elucidate single events and reactions. A number of problems in radiobiology are discussed in order to permit further investigations to be made with respect to tissue culture techniques, cytologic-cytochemical aspects, radiation genetics, and molecular biological aspects. The main emphasis is placed on the study of mammalian tissue culture cells and radioinduced interactions with the biological object. Investigations on population dynamics, colony size distribution, and karyological behavior of stemline cultures and single cells, and uv-microspectrophotometric measurements on living cells have been carried out. Furthermore, a method for the calculation of the uv-energy absorbed by living cells during irradiation is given and the performance and results of investigations for the determination of damaging effects in cells induced by uv-light and x-ray irradiation, the cytophotometric determination of the nucleic acid content of irradiated and unirradiated cells, and the molecule modifying effect of uv-light on the DNA synthesis are described. (GE)

15848 THEORETICAL ANALYSIS OF RADIATION SENSITIVITY IN CELLS FOLLOWING NEUTRON IRRADIATION. Leenhouts, H. P.; Chadwick, K. H. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wagening, Netherlands). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

There is increasing experimental evidence that the critical molecule in radiobiology is the DNA double helix. Recently a molecular theory has been developed starting from the assumption that double strand breaks in the DNA are the most critical lesions for cell killing. This theory is applied to all types of ionizing radiation and thus neutrons as well as gamma or x radiation are as-

sumed to cause the same type of primary damage. The difference between the neutron and gamma radiation effect is explained in the theory, by the different way in which these radiations induce the double strand breaks. Another biological end point that can be associated with damage to the DNA in a cell is a somatic mutation. If it is assumed that a DNA double strand break is the most critical radiation induced lesion that can lead to a somatic mutation, a general equation can be derived for the induction of mutations by radiation. The theoretical equations are compared with data in the literature for neutron and gamma or x radiation for the two phenomena. The implications of the theoretical considerations for plant mutation breeding and the sterile male technique are discussed with respect to the optimalization of the required process. (GE)

15849 MECHANISM OF RBE EFFECTS IN THE KILLING OF CELLS. Alper, T. (Hammersmith Hospital, London). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Nuremburg, Germany (22 Oct 1973).

With higher cells the dependence of RBE on dose results from differences in the shapes of dose-effect curves at different LET: extrapolation numbers are often lower for survival curves with neutron than with low LET radiation. Some models were set up having no general applicability, since, with bacteria, and even with some higher cells, the shapes of survival curves show no change over a wide range of LET and RBE values are therefore independent of dose. Classical target theory applies well to dry proteins and viruses as RBE decreases with increasing LET. Increases in RBE observed for the killing of pro- and eukaryotic cells strongly suggest that as ionization density increases there is an increase in the probability of interaction between two sites each of which has suffered an energy absorption event. Some insight into the nature of these sites has been gained by neutron and x-irradiation of microorganisms with differing capacities for repair or bypass of damage to nucleic acid. A model accounting for cell killing by ionizing radiations in terms of lesions in membranes as well as in DNA, was set up also accommodating the differences in RBE for microorganisms with different repair capacities. While energy deposition events in DNA and membrane may independently kill cells, there is evidence of interaction between such events. The probability of interaction is conceptually increased by recent studies demonstrating that DNA is intimately attached to the plasma membrane, in bacteria, and the nuclear membrane, in higher cells and that the points of attachment are also the origin of DNA synthesis. If RBE effects are to be accounted for by interaction of lesions engendered by single energy deposition events, reduction in OER with increase in LET must be accounted for in terms of the "oxygen in the track" hypothesis; which is supported by experiments on Chlamydomonas and bacteria. (GE)

15850 SYNCHRONIZATION OF THE CELL CYCLE OF L-CELLS IN THE G_2-PHASE BY FRACTIONATED X-RAY IRRADIATION AND ADMINISTRATION OF DAUNOMYCIN. Quantitative Determination of the Degree of Synchronization by an Impulse Cytophotometer. Linden, W. A.; Zywietz, F.; Landen, H.; Wendt, O. (Univ., Hamburg). Strahlentherapie; 146: No. 2, 216-225(1973). (In German).

The synchronization effect of x rays and Daunomycin on an exponentially growing culture of L-929-cells was quantitatively tested with the impulse cytophotometer (ICP). By fractionated irradiation with 200-kV x rays (total dose 225 rad, 9 fractions of 25 rad each in intervals of 3 hrs), about 70% of the cells can reversibly be kept in the G_2-phase of the interphase. The portion of G_2-cells in the unirradiated culture amounts to 12.9%. Daunomycin likewise produces reversible G_2-blockage on the L-cell culture. After application of Daunomycin in the concentration of 0.05 μg/ml, which proved to be optimal, after a 42 hr lasting period in influence, more than 80% of the cells were in the G_2-phase. An additivity of the synchronization effect of irradiation and Daunomycin was not observed. The results indicate that Daunomycin in the applied concentration also produces a G_1/S-blockage that possibly is the cause for the lack of additivity of Daunomycin and x ray irradiation in the synchronization effect. The authors point to a potential application of the described synchronization method in radiotherapy. (auth)

15851 EFFECT OF ULTRAVIOLET LIGHT ON THE SEDIMENTATION PROPERTIES OF TWO CELL-LINES WITH DIFFERENT SENSITIVITY TO UV. Fox, B. W.; Fox, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 24: No. 5, 497-504(Nov 1973).

The effect of uv irradiation on Yoshida sarcoma cells, sensitive and resistant to uv light, was studied by examining changes in the sedimentation-rate of the DNA on an alkaline sucrose gradient. The whole cells were lysed on the gradient at different periods of time after uv and at different doses, over a range 0 to 250 ergs/mm^2. After an immediate initial decrease, the sedimentation rate increased to a maximum at about 3 to 4 hrs after treatment. The uv-irradiated DNA sedimented faster than the untreated control after an equivalent amount of lysis time. The component that sedimented more quickly then decreased in amount between 4 to 6 hrs after irradiation and appeared as a component that sedimented very slowly near the surface of the gradient. The formation of a DNA-containing complex, was suspected, more pronounced in the sensitive cell-line than in the resistant. The sedimentation patterns occurring on more prolonged incubation of the cells were considered to be due to changes in DNA before the death of the cells. It is suggested that this faster-sedimenting complex may be associated with the excision system and that the efficient dissociation of this complex may be an intrinsic part of the repair process. (auth)

15852 MODIFICATION OF NEUTRON EFFECTS UPON CELLS BY REPAIR, AND BY PHYSICAL AND CHEMICAL MEANS. Berry, R. J. (Churchill Hospital, Oxford). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

The effects of neutron energy, dose-rate, dose-fractionation, the presence or absence of oxygen, and interactions with pharmacological agents upon the reproduction capacity and post-irradiation growth of neutron-irradiated mammalian cells are reviewed. There appear to be only quantitative, not qualitative differences between the effects of x- or gamma rays and those of the more energetic fast neutrons being used or proposed for radiotherapy of human cancer; the most striking differences emerge from the effects of fast neutrons of relatively low energy (approximately 1 MeV) such as those from ^{235}U fission spectra. (auth)

15853 QUANTITATIVE DESCRIPTION OF THE CELL RADIATION INACTIVATION PROCESS. II. Mathematical Equation of the Dose-Survival Relation. Bareukov, V. S.; Malinovskii, O. V. (Leningrad Inst. of Nuclear Physics, Gatchina, USSR). Tsitologiya; 15: No. 10, 1275-1283(Oct 1973). (In Russian).

Asymmetrical chromosome exchanges were found to be distributed in the cells in accordance with the Poisson law, a portion of surviving cells being associated with the average number of exchanges per cell by the equation $S = \exp(-m)$. The dose-dependence of the average number of exchanges makes it possible to draw an equation for the dose-survival curve involving two parameters: ξ —the primary radiosensitivity of the cell, K—the ratio between the rate of repair of primary lesions and that of their fixation in exchanges. The proposed dose-survival relationship fairly approximates by choice of the two parameters according to the suggested nomogram, the experimental survival curves including the threshold region. (auth)

15854 EFFECT OF CAFFEINE ON THE SURVIVAL AND CHROMOSOME ABERRATIONS YIELD IN X-IRRADIATED MAMMALIAN CELLS. Malinovskii, O. V.; Medvedeva, A. T.; Sigaleva, N. Ya.; Sheikina, T. A. (Leningrad Inst. of Nuclear Physics, Gatchina, USSR). Tsitologiya; 15: No. 10, 1304-1308(Oct 1973). (In Russian).

The effect of caffeine on the loss of reproductive capacity and chromosome aberration yield in x-irradiated HeLa and Chinese hamster cells was studied. Caffeine causes a 2 to 5 fold reduction of the cell survival and 2-fold increase of aberrant anaphases in exponential culture. This effect is equally displayed whether caffeine is added immediately after irradiation or 60 min later. The dose fractionation experiments did not reveal any effect of caffeine on the rate and value of sublethal lesion recovery. A conclusion is made of the lack of any direct association between the post-irradiation effect of caffeine on mammalian cell survival as well as the induction of chromosome aberrations and the fate of single-strand breaks in DNA. (auth)

15855 CELLULAR EFFECTS OF HEAVY CHARGED PARTICLES. Todd, P. (Pennsylvania State Univ., University Park); Schroy, C. P.; Schimmerling, W.; Vosburgh, K. G. Life Sci. Space Res.; 11: 261-270(1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

The human cell is rendered reproductively inactive by the passage of a single heavy ion through its nucleus when the heavy ion deposits energy at a rate greater than about 3500 MeV/cm. This is demonstrated by the correlation of inactivation probability with nuclear area when cells having nuclei of different sizes are compared. This single-hit inactivation is irreversible and unmodifiable. The ion path length over which cells will be inactivated in this way is calculable from stopping power theory. Laboratory experiments in which three-dimensional human cell cultures were irradiated

with high-energy nitrogen ions (3.9 GeV) at the Princeton Particle Accelerator confirm that cells are inactivated with maximum probability over the last 0.5 cm of the ion trajectory. This means that groups of adjacent cells in the ion path will be inactivated by a single ion with high probability. (IAA)

15856 RADIOBIOLOGICAL EFFECTS OF HEAVY IONS ON MAMMALIAN CELLS AND BACTERIA. Grigor'ev, Yu. G.; Rhzhov, N. I.; Krasavin, E. A.; Vorozhtsova, S. V.; Koshcheeva, L. A.; Savchenko, N. Ya.; Fedorenko, B. S.; Khlaponina, V. F.; Popov, V. I.; Kudriashov, E. I. Life Sci. Space Res.; 11: 247-259(1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

15857 EFFECT OF X IRRADIATION UPON HYDROCORTISONE INDUCTION OF ALKALINE PHOSPHATASE ACTIVITY. Goerner, L. W. Fort Collins, CO; Colorado State Univ. (1973). 91p. University Microfilms Order No. 73-29,035.

Thesis (Ph.D.).

Chinese hamster ovary cells synchronized by selectively removing mitotic cells from an asynchronous population were used to study the variation in alkaline phosphatase activity during the cell cycle. Whereas enzyme activity per cell normally remained constant during the 12–16 hour cell cycle, the enzyme activity in cells treated at mitosis with 5 μg/ml of hydrocortisone remained at the control level for only 5 hours (until the cells initiated DNA synthesis). As cells progressed into S phase, there was a 5–7 fold increasing in enzyme activity lasting until mid S some 12 hours after mitosis. Addition of hormone during G_1 and early S resulted in less induction than addition at mitosis. Delaying hormone addition until G_2 phase produced no induction in the first cycle and a 4 hour delay before induction started in the following generation. Both hormone and x-irradiation (1000 rads) of mitotic cells caused a 2-hour delay in entering S phase. Furthermore, when both treatments were administered simultaneously, the delay of entry was still 2 hours. In irradiated cells not treated with hormone, the enzyme activity increased (1.8 fold) prior to DNA synthesis, and then decreased to the control level during S phase. In the x-irradiated hormone-treated cells, the enzyme activity rose 2.5 fold during G_1 before a depression during mid-S. This depression was followed by a 2–3 fold rise during G_2. The early rise (G_1), depression during S, and reelevation during late G_2 all increased with dose. These radiation experiments demonstrate that enzyme induction and DNA synthesis are not necessarily tightly coupled. De novo synthesis of RNA and protein were necessary for induction of the enzyme. Actinomycin D (AMD) prevented any increase in enzyme activity when it was added to mitotic cells treated with hydrocortisone. However, when hormone was removed during S phase from cells induced during G_1, the addition of AMD caused, in about 2 hours after its addition, a rapid increase in enzyme activity. Cycloheximide produced a dramatic drop in activity immediately after it was added to S phase cells treated with hormone during mitosis. Inhibiting macromolecular synthesis by treatment of cells with medium made hypertonic by the addition of myo-inositol had an inhibitory effect identical to that observed following cycloheximide treatment. When the medium containing either myoinositol or cycloheximide was removed from the S phase cells and fresh medium with hormone was added, induction commenced immediately. Thus, while RNA synthesis is vital to induction only during mitosis and very early G_1, protein synthesis is required throughout the cycle for alkaline phosphatase activity to be maintained at an elevated level. Using data from actinomycin D, cycloheximide, and radiation studies, a model was developed that theorized the existence of a post-transcriptional repressor controlling the level of alkaline phosphatase activity. (Diss. Abstr. Inst., B)

15858 MOLEKULYARNAYA RADIOBIOLOGIYA KLETOCHNOGO YADRA. (Molecular Radiobiology of the Cell Nucleus). Kuzin, A. M. Moscow; Atomizdat (1973). 208p.

The major physico-chemical processes appearing in the nucleus of irradiated cells and serving as the basis of the radiation damage to cells, tissues, and organisms are examined. The vast literature material is generalized and systematically discussed. Radiation changes occurring in chromosomes, chromatin, nucleoproteins, and albumin of the nucleus, in comparison with the radiation displacements in the energy condition of the nucleus, the properties of its membrane, and with the reactions of low-molecular radiotoxins, are described. Special attention is given to reparative processes in the nucleus. (tr-auth)

15859 CLONOGENIC CAPACITY OF PROLIFERATING AND NONPROLIFERATING CELLS OF A TRANSPLANTABLE RAT RHABDOMYOSARCOMA IN RELATION TO ITS RADIOSENSITIVITY. Barendsen, G. W. (Radiobiological Inst., TNO, Rijswijk, Netherlands); Roelse, H.; Hermens, A. F.; Madbuizen, H. T.; van Peperzeel, H. A.; Rutgers, D. H. J. Nat. Cancer Inst.; 51: No. 5, 1521-1526(Nov 1973).

Repeated injections with tritiated thymidine at 4-hour intervals were used to label all proliferating cells (P cells) in a transplantable rat rhabdomyosarcoma to distinguish these cells from nonproliferating cells (Q cells). After the last injection, the tumors were excised and tumor-cell suspensions were prepared. From these suspensions, cells were cultured for different time intervals up to 120 hours. Labeled cells and clones in cultures of different ages were counted by autoradiography; this revealed that Q cells from this rhabdomyosarcoma have an approximately equal capability as P cells to produce clones of at least 16 cells within 4 days after plating. The labeling index of cells in 12-hour cultures was equal to that of cells in the tumors, which indicates that the cell-dispersion technique applied to prepare a cell suspension from the tumor did not preferentially select P or Q cells. Factors which can induce Q cells to begin proliferation are discussed. (auth)

15860 EFFECTS OF LOW PARTIAL PRESSURES OF OXYGEN ON THE RADIATION RESPONSE, REPAIR OF RADIATION DAMAGE, AND GROWTH KINETICS OF MAMMALIAN FIBROBLASTS. Koch, C. J. Waterloo, Ont.; Univ. of Waterloo (1972).

Thesis (Ph. D.).

Problems associated with the use of membrane-covered (Clark) polarographic electrodes for the microdetermination of the partial pressures of oxygen in unstirred liquids are considered. The sources of various instabilities and zero currents normally associated with these electrodes were analyzed. Through the solution of these problems the useful range of the oxygen cathode was extended to less than 50 ppM (oxygen) in gases or about 0.06 micromolar in liquids. Effects of low partial pressures of oxygen in the radiobiologically significant range were studied. Work done with synchronized cells at extremely low oxygen tensions showed that cells in the 5 phase of the cell cycle are not able to repair sublethal x-irradiation damage. The effect of various oxygen tensions on the radiation response and the repair of radiation damage for asynchronous cells was studied. The results show that if there are "normal" amounts of medium present (i.e., depth of approximately 0.4 cm), the survival curves show an apparent decrease in extrapolation number between partial pressures of oxygen of 20,000 to 1,000 ppM. This is caused by the radiochemical depletion of oxygen. The reduction in extrapolation number would probably be an important factor in vivo where there is effectively a large diffusion barrier to oxygen due to the amount of tissue present, corresponding to our experiments in vitro where there is a large amount of medium present. For split dose experiments (Elkind recovery) the threshold partial pressure of oxygen for recovery from radiation damage is of the order of 25 ppM. The effect of low oxygen tensions on the growth of asynchronous cells was investigated. At partial pressures of oxygen where an almost maximal radiation resistance occurs (due to the oxygen effect), growth is minimally affected. However, at oxygen levels of less than 500 ppM exponential growth is only possible for a limited number of divisions after which a plateau in growth is observed. The characteristics of cells subjected to long periods of growth at a very low oxygen tension are considered. The previously mentioned growth plateau results in an accumulation of cells in a pre-DNA synthetic state. However, the characteristics of these cells are very different from exponentially growing G1 cells suggesting that a transition to a non-cycling state, often referred to as Go, has occurred. (Diss. Abstr. Int., B)

15861 IN VIVO STUDY OF THE RELATIVE RADIOSENSITIVITY OF OXIC AND HYPOXIC TUMOR CELLS IN THE SOLID SARCOMA 180 AFTER IRRADIATION WITH HIGH OR LOW LET. External Measurements Using Labeled Iododeoxyuridine. Porschen, W.; Piepenbring, W.; Muehlensiepen, H.; Feinendegen, L. E. (Kernforschungsanlage, Juelich, Ger.). (1973). vp.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

The relative radiosensitivity of oxic and hypoxic tumor cells was analyzed using an in-vivo measuring method. The DNA of the tumor was labelled in vivo with ^{125}I or ^{131}I-iododeoxyuridine that can easily be externally measured for long periods. About 10^6 tumor cells were injected into the thigh of the experimental animals, NMRI mice. The growing tumors were locally exposed to 2,000 or 4,000 R min of γ radiation from a ^{137}Cs source, with a dose rate of 100 R; or with 15-MeV neutrons from a neutron generator of the type Dynagen 300, with a dose of 300 or 500 rads. After irradiation, an increase in cell loss was observed. This increase was found to depend on the dose, the type of irradiation, and the time interval between the labelling and the irradiation. The tumor cells irradiated under hypoxic conditions showed, as expected, a reduction of the radiosensitivity. The experimental technique is well suited to the in-vivo determination of the relative radiosensitivity of hypoxitic tumor cells. The data obtained by in-vivo experiments agree with those obtained by in-vitro experiments. (GE)

Radiation Effects on Microorganisms

Refer also to abstracts 15397, 15819, 15820, 15824, 15827, 15833, 15849, and 15938.

15862 (STI/DOC-10-149) MANUAL ON RADIATION STERILIZATION OF MEDICAL AND BIOLOGICAL MATERIALS. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. 337p.

Separate abstracts were prepared for 26 sections that discuss the radiosterilization of medical supplies, tissue grafts and transplants, and prostheses. A list of some 600 references is included. (CH)

For abstracts of individual sections see: 15479–15482, 15876–15896, and 16046.

15863 RADIATION LETHALITY IN ESCHERICHIA COLI. Gersten, D. M. Buffalo; State Univ. of New York (1973). 83p. University Microfilms Order No. 73-29,092.

Thesis (Ph. D.).

Survival, post-irradiation DNA degradation, and ability of hosts to excise pyrimidine dimers from phage T7 as a function of dose were studied in four strains of the B series of E. coli. The contribution to radioresistance of the three controlling loci by which the strains differ are additive both at the gross survival and dimer excision levels. The ability of hosts to excise dimers is not destroyed as a function of dose, indicating that ultimate lethality in this series of bacteria is due to a presentation of more damage to the cell than its repair system can restore. The implications of this are discussed. (Diss. Abstr.)

15864 DECOMPOSITION OF FOOD LIPIDS BY IONIZING RADIATION. Nawar, W. W. (Univ. of Massachusetts, Amherst). (1973). vp.

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

A number of animal and vegetable fats as well as model systems of triglycerides were used in a study to examine the effects of irradiation on the lipid fraction of foods. More than one hundred compounds were identified as radiolytic products. These include a series of hydrocarbons, aldehydes, esters, free acids, ethane- and propanediol diesters, propenediol diesters, diglycerides, triglycerides, ketones, glyceryl ether diesters, and 2-alkyl cyclobutanones. Reaction mechanism are proposed to explain the formation of the decomposition products. Bascially, these compounds result via the formation of free radicals according to preferential cleavages in the vicinity of the carbonyl groups. Since some of these compounds are unique to radiation effects, a method was developed to detect irradiation treatment in foods. Variables affecting the radiolytic pattern are discussed, and a comparison between thermolytic and radiolytic effects is presented. (GE)

15865 IDENTIFICATION OF IRRADIATED MEAT. Altmann, H.; Klein, W.; Dolejs, I. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf). (1973). vp. (In German).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

A study was made to determine gamma-ray induced significant changes in chicken meat; various methods were applied, and various important components were taken into account. The experimental results show that, apart from a partial stimulation in the range of low doses, no marked changes can be detected in the soluble proteins, the proteolytic activity, and in the nucleic acid pattern of chicken meat extracts irradiated with doses up to 0.5 Mrad. The only exception here is the DNA in which damages can be detected already after irradiation with 0.05 Mrad. A clear identification of irradiation damages in the soluble proteins is possible only after irradiation with high doses (preservation doses), with the meat of chicken legs being more sensitive to irradiation than the meat of chicken breasts, showing signs of degradation earlier than the latter. As regards the proteolytic activity, both types of meat exhibit a clear decrease of that activity after irradiation from 0.5 Mrad onwards, with the enzymes of leg meat being more effectively damaged by preservation doses than the breast meat. The ratio of low-molecular to high-molecular RNA increases continuously with increasing irradiation dose up to 5 Mrad. Considering the total RNA and DNA, only irradiation with 0.5 up to 1 Mrad will produce detectable changes. The significant response of the RNA/DNA ratio after gamma irradiation is due to a strong degradation of the DNA. An irradiation dose of 2 Mrad completely destroys the DNA, whereas irradiation below 0.5 Mrad can be detected only by gradient centrifugation. (GE)

15866 MICROBIOLOGICAL POSSIBILITIES TO DEMONSTRATE THAT STRAWBERRIES HAVE BEEN IRRADIATED. Tamminga, S. K. (Landbouwhogeschool, Wageningen, Netherlands); Beumer, R. R.; Kampelmacher, E. H.; van Kooij, J. G. (1973). vp.

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Samples of Dutch strawberries, greenhouse and outdoor-grown, were divided into portions, wrapped, and one of the portions was irradiated at 200 krad. The composition of the microflora before and after irradiation was investigated. The flora of the nonirradiated samples was composed mainly of gram-negative rod-shaped bacteria belonging, with only a few exceptions, either to the Enterobacteriaceae family (mainly Erwinia), or to the genus Pseudomonas. Moreover, moulds and yeasts were frequently encountered in varying quantities. Moulds and yeasts did not appear to make good indicator-organisms, as special groups or species, showing such sensitivity that they were always absent after irradiation were not demonstrable. Gram-negative rod-shaped bacteria on the other hand were always found to be absent after irradiation, when solid media were used, even when starting from samples with numbers in the order of magnitude 10^5 to 10^6/gm. Using outdoor-grown strawberries this always led to a clear difference from the corresponding untreated samples. Greenhouse-strawberries, however, sometimes contain only a very small number of microorganisms, so that the possibility should be taken into account, that none of the media show any growth without irradiation having taken place. Consequently, if gram-negative rod-shaped bacteria are present on strawberries (when using solid media) they have most probably not been irradiated. Of course this does not apply if post contamination has been possible. If there is no growth of the above-mentioned bacteria on any of the media used, there is a considerable possibility that irradiation has taken place. (GE)

15867 INVESTIGATION OF THE INTERACTION OF UV AND IONIZING RADIATIONS IN THE COMBINED IRRADIATION OF DIPLOID YEAST STRAINS WITH DIFFERENT RADIOSENSITIVITY. Schneider, E.; Kiefer, J. (Univ., Giessen, Ger.). (1973). vp. (In German).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

Combination experiments were made with three diploid yeast strains of different radiosensitivity in order to investigate the interaction of ionizing and nonionizing radiations. The strains used are the wild strain 211 and the two radiosensitive mutants S 2,094 and S 2,095. The results obtained show that interactions do occur: pre-irradiation with ionizing radiations reduces the uv plateau in the wild type, but it is not completely leveled down. In another strain, which is assumed to be recombination-negative, the uv plateau disappears completely after pre-irradiation with x-rays and alpha rays; in an excision-negative strain, however, irradiated under the same conditions, almost no interaction at all could be detected. From these results it is concluded that the x-ray/uv-light interaction occurs during excision repair and that the recombination system remains effective, regardless of the type of irradiation that induced the damage. (GE)

15868 STUDY OF UV-MUTAGENESIS IN BACILLUS SUBTILIS. II. Restoration of Biological Activity of Cellular DNA in Conditions Determining Different Sensitivity of Cells to the Mutagenic Action of Ultraviolet Light. Filippov, V. D.; Lekevichus, E. K. (Inst. of General Genetics, Moscow). Genetika; 9: No. 10, 97-105 (Oct 1973). (In Russian).

The frequency of uv-induced revertants to adenine (Ade) or methionine (Met) prototrophy as well as the frequency of double revertants (Ade Met), determined by one mutation, decreased in Bacillus subtilis cells irradiated in exponential phase, if they were subsequently incubated without nitrogen sources or with chloramphenicol (CA), and still more in the cells of stationary phase. The measurement of transforming activity (TA) of the ade6 and met5 markers of cellular DNA in the irradiated bacteria of isogenic prototroph strains provided the following results. Soon after irradiation the restoration of TA was observed in the cells of exponential phase incubated in nutritional medium. The rate of restoration decreased when incubation proceeded in a medium deprived of nitrogen sources or with CA. The long delay of the TA restoration can be seen in irradiated cells of the stationary phase. It is suggested on the basis of these data that a process, which depends on protein synthesis and provides a rapid restoration of TA of damaged cellular DNA, has mutagenic activity in Bac. subtilis. The nature of this process is under study in this labor-

atory. The low frequency of induced mutations in the cells of the stationary phase is proposed to be caused by decreased potential of protein synthesis in these cells. (auth)

15869 SUBSTRATE SPECIFICITY OF A BACTERIAL UV ENDONUCLEASE AND THE OVERLAP WITH IN VITRO PHOTOENZYMATIC REPAIR. Patrick, M. H.; Harm, H. (Texas Univ., Dallas). Photochem. Photobiol.; 18: No. 5, 371-386(Nov 1973).

The action of an endonuclease from Micrococcus luteus, that operates on ultraviolet(uv) radiation damage, overlaps greatly with that of the yeast photoreactivating enzyme: homo and hetero cyclobutylpyrimidine dimers in DNA are substrate for both enzymes, but pyrimidine adducts or the "spore photoproduct" in DNA are not. As expected from this overlap, the action of the two enzymes was mutually interfering: single-strand nicks introduced by the endonuclease effectively precluded photoreactivation: conversely, formation of a photoreactivating exzyme-dimer complex prevented nicking by the uv endonuclease. While complex formation between photoreactivating enzyme and dimers in uv-endonuclease-treated DNA was apparently normal, the light-dependent repair step either failed to occur or proceeded at a very low rate. Hence, besides the requirement of a minimum chain length for the function of the photoreactivating enzyme, there was the additional restriction on the position of the dimer in a polynucleotide strand. Rough approximations of the rate constants, k_1 and k_2, for the uv endonuclease indicated that the in vitro uv-endonuclease-dimer complex is relatively unstable, with dissociation of the complex being more probable than hydrolysis of the phosphodiester bond. (auth)

15870 UV-INDUCED MUTABILITY TO PROTOTROPHY IN ISOGENIC STRA$^+$ AND STRA$^-$ STRAINS OF ESCHERICHIA COLI. Skavronskaya, A. G.; Aleshkin, G. I.; Likhoded, L. Ya. (Inst. of Epidemiology and Microbiology, Moscow). Genetika; 9: No. 10, 163-165(Oct 1973). (In Russian).

The introduction of the str A$^-$ mutation was shown to decrease ten-fold the yield of uv-induced reversions to prototrophy as compared with an isogenic str A$^+$ strain. The decrease is due to inability of the majority of induced suppressors to be expressed phenotypically in the str A$^-$ strain in the course of selection. Streptomycin reversed this effect. The uv-induced suppressors were shown to differ in ability to be restricted by the str A$^-$ mutation. (auth)

15871 SUPEROXIDE DISMUTASE AND THE OXYGEN EFFECT. Goscin, S. A.; Fridovich, I. (Duke Univ., Durham, NC). Radiat. Res.; 56: No. 3, 565-569(Dec 1973).

The potential role of the superoxide radical in the molecular mechanism of the oxygen effect was investigated by measuring oxygen enhancement ratios for Escherichia coli B cells containing high and low levels of the enzyme superoxide dismutase. The level of superoxide dismutase in the cells was found to have no effect on the oxygen enhancement ratio. This result is not consistent with the proposition that the superoxide radical is involved in the mechanism of the oxygen effect. (auth)

15872 ROLE OF REPAIR MECHANISMS IN THE VARIATIONS OF ULTRAVIOLET AND γ-RADIATION SENSITIVITY DURING THE CELL CYCLE OF SCHIZOSACCHAROMYCES POMBE. Fabre, F. (Institut du Radium, Orsay, France). Radiat. Res.; 56: No. 3, 528-539(Dec 1973).

The lethal effects of uv and γ rays were studied on synchronized cells of S. pombe with different defects in their repair pathways: UVS A cells do not excise pyrimidine dimers; UVS 1 cells are probably deficient in a repair mechanism related to recombination. UVS$^+$ (wild-type) cells, after uv and γ-irradiation, and UVS A cells after γ-irradiation, are the most resistant in the G2 phase of the mitotic cycle. These observations support the existence of a repair mechanism, which acts on uv- and γ-induced lesions before DNA replication and is different from that of excision-resynthesis. After uv irradiation, it requires the participation of an incision enzyme also involved for excision repair. The uv response of UVS A cells is constant during the cycle, suggesting the presence of a repair mechanism acting during or after DNA replication. The uv resistance of UVS 1 cells decreases progressively from the beginning of the G2 to the end of the S period. This is interpreted in terms of delay available for excision repair. The practically constant response to uv of UVS A and of the double mutant UVS 1A, and to γ-rays of UVS 1A cells indicates that when variations occur, they are mainly due to differential repair abilities within the cycle. (auth)

15873 INCIDENCE AND REPAIR OF X-RAY INDUCED SINGLE STRAND BREAKS IN DNA OF ESCHERICHIA COLI K12 CELLS. Hernadi, F. (Hungaryi Orvostudomanyi Egyetem, Debrecen); Gabor, R.; Csongor, J. Izotoptechnika; 16: No. 10, 578-583(Oct 1973). (In Hungarian).

Irradiation with a dose of 15 krads significantly changed the sedimentation pattern of DNA. The bacteroid strain has an effective repair system, as the cells repaired the breaks in one hour. Certain metabolic changes increased; hydroxyurea decreased the recovery of breaks. (auth)

15874 RADIOSENSITIZATION OF BACTERIAL SPORES BY POTASSIUM PERMANGANATE. Tallentire, A.; Jones, A. B. (Univ. of Manchester, Eng.). Int. J. Radiat. Biol.; 24: No. 4, 345-354(Oct 1973).

Potassium permanganate sensitized spores of Bacillus megaterium in anoxic phosphate buffer (pH 7.0) or water suspension to the lethal effects of gamma rays. At sufficiently high concentrations, ($\sim 10^{-2}$ M) it increased the radiation sensitivity to a level equivalent to that seen for spores in suspension in equilibrium with oxygen, but did not enhance the sensitivity of spores oxygenated fully. Under conditions where responses due to oxygen presence were sub-maximal, potassium permanganate increased radiation sensitivity, but only to a level achieved maximally by oxygen alone; oxygen and potassium permanganate sensitizing effects were thus additive within the oxygen effect. The proposal is made that potassium permanganate acts, in part, in wet spores by oxidation of those radiation-induced free radicals, produced directly in target molecules within spores, that can also be made harmful by interaction with oxygen. (auth)

15875 RBE OF THE $^{10}B(n,\alpha)Li$ CAPTURE REACTION OF THERMAL NEUTRONS INSIDE THE GREEN ALGA CHLORELLA PYRENOIDOSA. Knoop, H. U.; Paschke, M. (Kernforschungsanlage, Juelich, Ger.). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

Unicellular green algae, Chlorella pyrenoidosa, are grown in nutrient solutions containing 100 mg/l of $H_3{}^{10}BO_3$ and $H_3{}^{11}BO_3$ respectively, and are then irradiated in the thermal column of the 10 MW-swimming-pool-reactor FRJ-1 "Merlin." The measured difference in the colony-forming ability of the cells and the uptake of sodium after irradiation is due to the $^{10}B(n,\alpha)^7Li$-capture reaction of thermal neutrons. The ^{10}B-reaction reveals a high dose related effectiveness in damaging the colony-forming ability of the cells. The slope of the nearly exponential dose effect-curve is 721×10^{-6}/rad, compared to 598×10^{-6}/rad for the $^{14}N(n,p)^{14}C$-reaction, 230×10^{-6}/rad for fission neutrons, and 118×10^{-6} for x rays. However no effect is to be measured on the uptake of ^{24}Na-ions by the ^{10}B-reaction, while all other reactor radiations together damage very effectively. The results are briefly discussed. (GE)

15876 PHYSICAL CHARACTERISTICS OF IONIZING RADIATION. McLaughlin, W. L. (National Bureau of Standards, Washington, DC); Holm, N. W. pp 5-12 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Data are reviewed on basic physical processes by which ionizing radiation react with matter in relation to the mechanisms involved in killing microorganisms. In the case of direct action it is assumed that the incoming particle ionizes one part of a DNA molecule, an enzyme, or some other sensitive region such as the cell membrane or cell nuclei causing changes in respiratory function or mitosis that lead to cell death or significant changes in the character of the cell. All microorganisms contain some moisture and the release of radiation energy leads to chemical reactions by which free radicals such as OH and H and molecules such as H_2O_2 are formed, which react chemically with vital components of the organism and can indirectly lead to lethal damage. It is pointed out that all types of ionizing radiations lead to such reactions, but vary in their effect in relation to differences in energy transfer mechanisms, dose rate, and other response modifying factors. (CH)

15877 EFFECT OF IONIZING RADIATION ON SOME MOLECULES OF BIOLOGICAL IMPORTANCE. Antoni, F. (Semmelweis Univ. of Medicine, Budapest). pp 13-35 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Data are reviewed from studies on the effects of ionizing radiation on molecules in biological materials relevant to mechanisms involved in the killing of microorganisms by irradiation. Topics discussed include: the radiolysis of water; the denaturation of proteins; and effects on the molecular structure of carbohydrates. (CH)

15878 EFFECT OF IONIZING RADIATION ON BACTERIA. Ley, F. J. (Irradiated Products Ltd., Wilts, Eng.). pp 37-63 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Factors affecting the radiosensitivity of bacteria are discussed

in relation to the requirements for the radiosterilization of medical supplies and biological materials injected into patients. Emphasis is placed on differences in radiosensitivity between bacterial species and strains, vegetative cells, and spores. The influence of environmental oxygen, water, and temperature is considered. The effects of radiation dose, dose rate, and dose fractionation on the lethal effects of electrons, γ, and x radiation are discussed. Mechanisms of radioinduced inactivation of bacteria are reviewed. (CH)

15879 EFFECT OF IONIZING RADIATION ON VIRUSES. Pollard, E. C. (Pennsylvania State Univ., University Park). pp 65-71 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Factors affecting the radiosensitivity of viruses are discussed in relation to the requirements for the radiosterilization of medical supplies and biological materials injected into patients. Data on the radioinactivation of the various attributes of viruses are reviewed, with emphasis on the inactivation of infectivity. The importance of the elimination of every active particle of the virus is stressed and the influence of moisture on radiosensitivity is discussed. The mechanisms for the inactivation of viruses in aqueous solutions by the effects of radiation on the medium are reviewed and the synergistic effects of heat and radiation for the destruction of virus infectivity are discussed. The wide variability in viruses requires that each separate one be tested for inactivation by electrons, γ, or x radiation. The effectiveness of radiosterilization for the preparation of vaccines and for the sterilization of viruses on sutures and in blood used for transfusions is discussed briefly. (CH)

15880 EFFECT OF IONIZING RADIATION ON FUNGI. Sommer, N. (Univ. of California, Davis). pp 73-79 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Fungus spores are common contaminants of medical supplies that need to be sterilized. Their radiation sensitivity is influenced not only by genetic factors but also by the number of cells in a spore, the number of nuclei per cell, and by ploidy. Germination is not a reliable indication of spore survival in fungi because many irradiated spores die only after considerable germ tube development. Heating before or during irradiation may increase the sensitivity of fungus spores to radiation. The presence of oxygen or media during irradiation as well as the presence or absence of a recovery period between irradiation and germination may influence spore survival. The radiation resistance of fungus spores is usually much less, however, than the resistance of important spore-forming bacteria. Presumably a radiation treatment sufficient to inactivate bacterial contamination will normally eliminate fungal contamination. (auth)

15881 DOSIMETRY. Holm, N. W. (Danish Atomic Energy Commission, Risoe). pp 99-109 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

In the radiation sterilization of medical and biological materials the regulatory authorities usually specify restricted ranges of radiation absorbed doses for the purposes approved. In principle there should be no objection to treating these processes like any other industrial process, except that conventional product control of medical and biological materials has to be carried out by means of sterility testing, a procedure that can no longer be considered sensitive enough for testing whether a product meets the stringent bacteriological standards in use today. As a substitute for the biological product control, the efficiency of the integrated sterilization process is challenged by inserting special biological indicators containing large numbers of highly resistant bacteria of pure cultures at product locations where the bactericidal effect is supposed to be minimal. This is also done as a routine process in autoclaves and gas sterilizers. In radiation sterilization it has now been generally accepted that such minimum-effect locations can be adequately checked by absorbed-dose measurements. Once an inactivation efficiency versus dose relationship has been established for relevant test strains of bacteria in the given irradiation facility, further process control by means of biological indicators may often be dispensed with. One may define the role of absorbed-dose dosimetry in radiation sterilization of medical and biological materials as an indirect method of controlling the most vital parameter of the process: the inactivation efficiency under the given conditions. Based on the specific dosimetry suggestions compiled in the IAEA's Recommended Code of Practice for Radiosterilization of Medical Products (IAEA, 1967b), some of the steps involved in setting up an irradiation procedure and a number of practical points concerning choice and handling of various dosimeter systems are presented. The effectiveness of aqueous chemical dosimeters, various commercial plastic dosimeters, and photographic film dosimeters for measurements of absorbed dose at product locations and for the calibration of the ^{60}Co γ sources is discussed. (CH)

15882 PACKAGING REQUIREMENTS. Powell, D. B. (RWP Flexible Packaging Ltd., Bristol, Eng.). pp 111-129 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

The prime function of packaging for a presterilized medical item is to ensure that the sterility of the contents is maintained up to the time the package is intentionally opened and that provision is made for the contents to be removed without contamination. Failure to achieve this aim negates the efforts to control sterilization methods and the standards of sterility that have been set. A recent recommendation that any sterilization procedure should achieve a statistical probability of not more than one nonsterile article occurring in one million articles processed, loses its practical significance if the package fails to achieve a similar standard. To achieve such standards, many factors involved in the design and manufacture of a package must be carefully considered including the suitability of packaging material for the sterilization method; resistance of the material to bacteria; type of package; type of opening; strength of package; and testing of the package. Methods used for the evaluation of packaging are described. (CH)

15883 HYGIENIC REQUIREMENTS, STERILITY CRITERIA, AND QUALITY AND STERILITY CONTROL. Christensen, E. A. (Statens Seruminstitut, Copenhagen). pp 131-152 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

The demands made on the quality of radiation-sterilized products should be the same as those made on products sterilized by other methods. The control methods to be applied are therefore also in general the same as those applied in the control of medical products sterilized by autoclaving or by ethylene oxide, although the special conditions of radiation sterilization necessitate some modification. The emphasis in the microbiological control of medical products is no longer placed on sterility testing of the end product, but rather on continuous control of the entire manufacturing process including the sterilization procedure. Sterility control methods applicable to radiosterilization are discussed. (CH)

15884 LEGAL ASPECTS. Crawford, C. G. pp 153-161 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agench (1973).

With the commencement of large-scale industrial γ radiation sterilization of medical supplies from 1962 onwards it was realized that standards would have to be set both nationally and internationally to ensure that the process was carried out properly and in such a way that the inherent reliability of the process could be maintained and also documented. A recommended code of practice is presented as a guide or reference document to be used in drawing up national legislation. Its use should help to clarify questions arising when radiation-sterilized medical products are transferred from one country to another. No country has so far incorporated the code of practice in its entirety into any form of national legislation, but many countries recognize the usefulness of the code and have adopted substantial parts into their regulations governing sterility control. Many of the recommendations of the code of practice apply equally well to other methods of sterilization and it is desirable that any national legislation should provide for uniform conditions, whether the sterilizing agent is heat, a chemical substance, or ionizing radiation. The recommendations are summarized. (CH)

15885 SUTURES. Artandi, C. (ETHICON Inc., Sommerville, NJ). pp 173-186 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

The first industrial scale radiosterilization of medical supplies was that of surgical sutures. Since 1956 the majority of sutures in the United States of America have been radiosterilized. This has also been true throughout the world since the early 1960s. There are many reasons why sutures were well suited for large-volume commercially radiosterilization. They presented a unique opportunity for innovation in a highly competitive industry that used small numbers of basic materials in large numbers of products. The existing methods of sterilization were less than satisfactory because of their adverse effects on product quality. Moreover, the choice of packaging materials was restricted because of the heat-sterilization process then in common use. Since the manufacture of sutures involves a relatively high labour cost and the product has a high value to volume ratio, the cost of sterilization is not an appreciable factor in the total cost picture. Radiosterilization made it possible for the suture industry to change

its packaging from glass to plastic. This represented a significant consumer advantage because the quality of both the product and its package was improved. Applications of γ radiation in the sterilization of both absorbable and non-absorbable sutures are discussed. (CH)

15886 PLASTIC AND RUBBER INSTRUMENTS AND APPARATUS. Artandi, C. (ETHICON Inc., Sommerville, NJ). pp 187-190 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

The advantages of using ionizing radiation for the sterilization of disposable medical supplies made of a wide variety of plastics and rubbers are pointed out. Radiosterilization is especially useful for items combined into trays, packs, and kits for specific procedures since it allows the choice of plastics and packaging materials. Data on radioinduced changes in the chemical, physical, and mechanical properties of plastics and rubbers are reviewed that show that the materials commonly used in the manufacture of disposable items are not changed at radiation doses sufficient for sterilization. (CH)

15887 EQUIPMENT FOR PRESERVATION OF BLOOD AND BLOOD TRANSFUSION. Emborg, C. (Danish Atomic Energy Commission, Risoe). pp 191-198 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

The advantages of using ionizing ratiation for the sterilization of disposable plastic bags used for the storage of blood to be used for transfusions and for the sterilization of disposable equipment used for the intravenous injection of blood into patients are discussed. Sterility standards for blood bank equipment are reviewed and it is pointed out that in many cases radiation sterilization is the only sterilization method available that can meet the rigid standards. (CH)

15888 NONBIOLOGICAL MATERIALS FOR IMPLANTATION AND FOR USE IN CONTACT WITH CIRCULATING BLOOD. Little, K. (Ridgeway Consultants, Abingdon, Eng.). pp 199-206 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Various methods used for the sterilization of plastic or metal prosthetic devices used as implants in patients are reviewed. It is pointed out that only a few plastic materials and metals are suitable for permanent implantation since they are subject to stress corrosion and decomposition through chemical reactions with body fluids, especially when they come in contact with circulating blood. Data on the effects of radiation on the stability of some materials used for prostheses are reviewed and the feasibility of radiation sterilization is discussed. The choise of sterilization method used (radiation, autoclave, or ethyl alcohol bath) must be evaluated in relation to the nature of the material and technical factors concerned with its use. (CH)

15889 MEDICINES AND PHARMACEUTICAL BASE MATERIALS. Phillips, G. O. (Univ. of Salford, Eng.). pp 207-228 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Radiation sterilization of pharmaceuticals is now possible and examples where the method is now being employed commercially are discussed. However, it is pointed out that this is not a universal method that can be used on any system when other more conventional methods have been found wanting. It is a specific method, which requires careful choice of the conditions. Use of the method presents a battle between sterilization requirements and the accompanying chemical decomposition. If the basic principles of radiation chemistry are borne in mind, then the extent of radiation damage can often be reduced to acceptable levels if suitable conditions of dose, solute concentration, atmosphere, nature of the accompanying materials, etc. are selected. If more stringent sterilization requirements are demanded, then the available methods will come under greater pressure and under these conditions radiation sterilization could offer unique advantages. (CH)

15890 BIOLOGICAL MECHANISMS. Little, K. (Ridgeway Consultants, Abingdon, Eng.). pp 233-243 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Uniform success in tissue grafting or organ transplant operations requires an understanding not only of the technical factors that lead to the success of an operation but also of the underlying biological mechanisms. The present state of knowledge of some of these biological mechanisms that come into play during the process of tissue grafting and can be used as a basis for more detailed research for special applications is discussed. The whole subject is still at such an early stage of development that the knowledge on which to base unequivocal recommended procedures is needed. The sterilization of medical products by the use of radiation doses in the range of 1 to 4 Mrad has been carried out and these radiation doses sterilize biological tissues also, but they have other effects that may be more important. The factors that appear to be responsible for rejection reactions in organ transplantation seem to be inactivated. Cells are killed, and the physical properties of the tissues in the graft are modified. Such physical and chemical modifications affect the incorporation of the graft and its replacement by host tissue and in practice it is best to choose the optimum radiation dose so far as these tissue properties are concerned. This is not necessarily the dose that is customary for the routine sterilization of medical products. In the preparation and use of tissue grafts there are a number of variables that have to be considered, of varying degree of importance, including: type of irradiation, dose, and dose rate; temperature of storage, irradiation, and subsequent storage; time between death and irradiation, and between irradiation and use; handling and possible mechanical damage; medium in which irradiation takes place; environment during storage; and stabilization versus degradation. For any particular grafting procedure that may be contemplated the previously mentioned variables can only be found by trial and error or animal experiments. The limits for other possibilities can be set when the appropriate biological mechanisms are known. These more general considerations include the stimulating factors for tissue growth, regeneration, and resorption, calcification, inflammatory reactions, and modifications for special cases such as bone, nerve, and vascular tissues. (auth)

15891 REVIEW OF PREPARING TISSUE GRAFTS FOR SURGICAL USE WITH SPECIAL REFERENCE TO GAMMA RADIATION. Dexter, F. (Pinderfields General Hospital, Wakefield, Eng.). pp 245-256 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

A brief review is presented of methods for the preparation of biological tissue for grafting to serve as a guide for those embarking on tissue banking procedures. One of the chief considerations in preparing tissue grafts for surgery is that the methods of processing should in no way inhibit the functional role of the tissue grafts. Since the function of each graft is specific, the method of preparation should be applied accordingly and be consistent with clinical requirements. Applications of radiosterilization in the preparation of skin grafts, dura mater grafts to close meningeal defects and also around heart valve grafts, bone grafts, and homograft or heterograft heart valves are discussed. (CH)

15892 USE OF ELECTRON STERILIZATION WITH PARTICULAR REFERENCE TO BONE AND NERVES. Campbell, J. B. (Milbank Research Labs., New York); Wright, K. A. pp 257-265 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

The radiosterilization of human nerves for use in performing transplantation or bone for grafting is relatively simple, provided one has suitable radiation facilities available. The advantages of using electrons for radiosterilization are discussed. (CH)

15893 SURGICAL ASPECTS. Gibbons, J. R. P. pp 267-272 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

A brief review is presented of applications of radiation sterilization in the preparation of tissues for use as grafts or transplants. The tissues discussed include blood vessels, peripheral nerves, tendons, bones, facia lata, dura mater, and homograft heart valves. (CH)

15894 OBSERVATIONS ON THE CLINICAL USE OF FREEZE-DRIED, IRRADIATED ALLOGRAFTS IN BONE TRANSPLANTATION. Triantafyllou, N. M. (Democritus Nuclear Research Centre, Athens). pp 273-281 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Bone grafting is a well-known operative procedure with many applications in orthopedic surgery. There is an increasing need for transplantable material, i.e. bone grafts from the patient who is going to be operated on (autografts), from other human donors (allografts), or from different animals (xenografts). Allografts and xenografts are usually provided from bone banks. Various methods of sterilizing and preserving bone grafts have been developed. Fresh bone autografts are the best material for transplantation and the best bone bank for each person is in his own iliac crest and tibia. Preserved allografts are distinctly superior to similar xenografts. This superiority has been proved by many experimental and clinical observations and applies not only to bone, but generally to all kinds of organ or tissue transplants. The main problem of bone transplantation lies not only in the choice of auto-, or allo-, or xeno-graft but rather in the choice of a graft

that has been prepared by the best method or procedure. The critical points of bone graft sterilization and preservation are: sterilization; immunological inactivation; and long-term preservation of the grafts. The best methods of bone preservation and sterilization have been found to be freeze-drying and high doses of irradiation. (CH)

15895 ORGANIZATION OF TISSUE BANKS BASED ON THE RADIOSTERILIZATION TECHNIQUE. Ostrowski, K.; Moskalewski, S. (School of Medicine, Warsaw). pp 283-289 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Experience in organizing and running a central tissue bank for more than 7 years is reported. The operating principle of this bank is radiosterilization of tissues processed in such a manner that they can afterwards be kept at room temperature. Tissue banks based on radiosterilizing frozen tissues and distributing them in the frozen state are also discussed. The preserved tissues are used as biostatic grafts, i.e. devitalized tissues that serve as biological prostheses and in some cases are substituted by the host's own tissues. Grafts preserved by lyophilization or other methods and sterilized by irradiation offer the following advantages: long durability of preserved tissues; lowering or complete suppression of tissue antigenicity; sterility; easy transport, distribution, and storage in hospitals; and relatively low cost of graft production and handling. (CH)

15896 RADIOSTERILIZATION OF PREPARED VACCINES. Tumanyan, M. A. (Inst. for Epidemiology and Microbiology, Moscow). pp 291-292 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Most vaccines used for the prevention and therapy of infectious diseases are administered parenterally and must also be sterile. Sterilization by heat cannot be used for the vaccines as the high sterilizing temperature destroys the essential antigens and thereby renders the vaccine non-immunogenic and non-functional. For the sterilization of already prepared vaccines the applications of ionizing radiation have proved successful and will lead to the broadening of the overall scope for the techniques of radiosterilization in the medical industries. A considerable amount of research is currently underway to investigate the effects of irradiation on vaccines as a means to further improve the efficiency and economy of the radiation sterilization techniques. (auth)

15897 UNFOLDING OF THE HOST GENOME AFTER INFECTION OF ESCHERICHIA COLI WITH BACTERIOPHAGE T4. Tutas, D. J.; Wehner, J. M.; Koerner, J. F. (Univ. of Minnesota, Minneapolis). J. Virol.; 13: No. 2, 548-550(Feb 1974).

The folded genome of Escherichia coli is converted to a slower-sedimenting form within 5 min after infection with bacteriophage T4 or T4nd28(den A)-amN82(44). Chloramphenicol sensitivity and response to uv-irradiation of the phage suggest participation of viral-induced functions. (auth)

15898 CHANGES IN SURVIVAL OF ESCHERICHIA COLI K-12 CELLS AS A FUNCTION OF THE MEDIUM IN WHICH THEY ARE X-IRRADIATED. A Rec and Exr Gene-Dependent Phenomenon. Van der Schueren, E.; Youngs, D. A.; Smith, K. C. (Stanford Univ., CA). Int. J. Radiat. Biol.; 24: No. 4, 355-362(Oct 1973).

Escherichia coli K-12 wild-type cells suspended in growth medium during x irradiation have a higher survival than cells irradiated in buffer, whether irradiated in air or nitrogen. To determine if this response was due to differences in radiochemistry during irradiation or to differences in the amount of repair, the influence of the irradiation medium on the survival of several repair-deficient mutants (recA, recB, exrA, uvrB, polA1, and polA1 exrA) and the repair of radiation-induced DNA single-strand breaks in a wild-type strain were studied. The studies showed that the effect of the irradiation medium on survival was dependent on the presence of functional recA, recB, and exrA genes. Sedimentation studies, however, did not show a difference in the final amount of repair of DNA single-strand breaks after x irradiation in buffer or growth medium. Thus, the increased x-ray sensitivity resulting from irradiation in buffer appears to be due to the inhibition of some rec and exr gene-dependent repair process other than the repair of DNA single-strand breaks. (auth)

15899 CONSTANCY OF THE UV SENSITIVITY OF E. COLI DURING THE CELL CYCLE. Kubitschek, H. E.; Finney, A. C.; Krisch, R. E. (Argonne National Lab., IL). Photochem. Photobiol.; 18: No. 5, 365-370(Nov 1973).

Cells from slowly growing glucose-limited chemostat cultures of two different strains of Escherichia coli were separated by size on sucrose gradients, and 254-nm ultraviolet (uv) survival curves were obtained for samples of the different cell sizes. With the repair-deficient strain B_{s-1} there was no observable change in survival curve during the cell cycle. With the repair-proficient strain 15 THU, there was no observable change in the final slope, but y-axis intercepts increased slightly for the older cells. It is suggested that the results provide further evidence for the approximate independence of uv sensitivity, k, upon cell age within the division cycle and upon the presence or absence of DNA synthesis, and that they are consistent with a model in which uv lesions in newly replicated strands of DNA do not contribute to lethality. (auth)

15900 RECOVERY AND REPAIR IN YEAST CELLS AFTER IRRADIATION WITH HIGHLY IONIZING PARTICLES. Pohlit, W.; Schaefer, M. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

A cybernetic model was developed for radiation effects in living cells. This model includes quantitative changes in radiation sensitivity with absorbed dose, recovery (split-dose reactivation) and repair (liquid-holding reactivation). The model was tested extensively with sparsely ionizing radiations (x rays and electrons) using diploid and haploid yeast cells. Experiments are described in which the model is used for analyzing irradiation with alpha particles from an americium source. These particles are representative of densely ionizing particles with known LET-distribution of absorbed dose. It can be shown quantitatively how much the unrepairable fraction of the radiation damage is increased in comparison with sparsely ionizing radiations. The quantitative data can be used for a prediction of reactions of fast and slow neutrons of various energy distributions. Consequences of these results for radiation therapy with fast neutrons and for radiation protection are discussed. (GE)

15901 SYNTHESIS OF RNA IN SACCHAROMYCES AFTER PHOTODYNAMIC TREATMENT OR IRRADIATION WITH X RAYS. Micheler, A.; Pietsch, I.; Lochmann, E. R. (Freie Univ., Berlin). Biophysik; 10: No. 3, 249-256(Oct 1973). (In German).

RNA synthesis in Saccharomyces was investigated up to 10 h after x-irradiation or photodynamic treatment with thiopyronine and visible light. Even with high doses of x rays RNA synthesis is only very slightly inhibited in all cells up to about 2 h after irradiation. Then RNA synthesis decreases strongly in cells that cannot divide. On the contrary, after photodynamic treatment the inhibition of RNA synthesis in cells which lost their colony-forming ability begins immediately. In cells not inactivated in colony-forming ability, RNA synthesis shows nearly the same extent as control cells. These results give further supports that inactivation by photodynamic action in yeast cells is not caused by DNA damage, which is the case after irradiation with x rays, but by inactivating plasmatic structures. (GE)

15902 TEMPERATURE SENSITIVE RADIOSENSITIVE MUTANTS OF THE YEAST SACCHAROMYCES PARADOXUS. Bandas, E. L.; Bekker, M. L.; Luchkina, L. A.; Tkatchenko, V. P.; Zakharov, I. A. (Inst. of Nuclear Physic, Leningrad). Mol. Gen. Genet.; 126: No. 2, 153-164(Nov 1973).

The properties of four radiation sensitive ts mutants of the yeast Saccharomyces paradoxus, txs_1, txs_2, txs_4 and txs_5, were studied. The mutants are sensitive to x rays and ultraviolet. Holding at 37°C in a complete medium but not in water sharply decreases the viability. With txs_2 this effect could also be observed in water. The mutants formed filaments and showed abnormal cytokinesis under restrictive conditions, this effect being the most pronounced with txs_4. The frequency of mitotic recombination induced by x rays and uv is much lower in the mutants (except txs_2) as compared to the wild type. Restrictive temperature somewhat increased the mitotic recombination in the mutants (except txs_4). Shift of the mutants into restrictive temperature leads to immediate inhibition of DNA synthesis; the extent of this inhibition correlates with the levels of radiation and temperature sensitivity, both being higher in txs_2 and txs_4. Elevated temperature also decreased RNA and protein synthesis in txs_2. It is suggested that mutation txs_2 affects a function participating at the last stages in postirradiation repair of DNA, probably DNA ligase. The txs_4 seemed to affect the process of nuclear division. (GE)

15903 REGULATION OF BIOSYNTHESIS OF SECONDARY METABOLITES. XV. Isolation and Characterization of Auxotrophic Mutants in Streptomyces Aureofaciens. Blumauerova, M.; Ismail, A. A.; Hostalek, Z.; Callieri, D. A. (Inst. of Microbiology, Prague). Folia Microbiol. (Prague); 18: No. 6, 474-491(1973).

Auxotrophic mutants of Streptomyces aureofaciens, necessary for a further genetic analysis, were obtained by treating standard strains and their mutants (differing by their biosynthetic activities)

with uv-radiation and N-methyl-N'-nitro-N-nitrosoguanidine (MNG). Mean frequencies of induced mutations varied within 0.001 to 0.18% depending on the strain and experimental conditions. Doses of uv radiation and MNG yielding 0.1 to 0.9% and 0.001 to 0.0009% survival, respectively, were found to be most effective. The technique of subsequent enrichment was found to be more useful for the detection of mutants than the technique of total isolation. Most isolated auxotrophs required arginine. Among other growth factors, methionine, purine bases and serine (or glycine) were frequently required. A new modification of the enrichment technique utilizing a synthetic arginine-free medium was worked out for the exclusion of the arg mutants. The nutritional deficiency was in most auxotrophs associated with a decrease or a complete loss of the ability to produce secondary metabolites. Difficulties caused by unequal mutation patterns and high unstability of mutants as well as presumable loci of certain genetic blocks leading to auxotrophy are discussed. (auth)

15904 EFFECT OF AMINO ACID STARVATION ON UV SENSITIVITY OF LACTOBACILLUS ACIDOPHILUS CELLS. Soska, J.; Necasova, J. (Inst. of Biophysics, Brno). Folia Microbiol. (Prague); 18: No. 6, 455-462(1973).

In Lactobacillus acidophilus cultures uv irradiated in the exponential phase of growth, the dose-survival curve was of the simple exponential type, without any shoulder. If the bacteria were subjected to amino acid starvation prior to irradiation, a shoulder corresponding to a quasi-threshold dose (D_q) of about 780 ergs/mm^2 appeared in the curve. The administration of protein- or RNA-synthesis inhibitors prior to irradiation had the same effect. The effect of pre-irradiation amino acid starvation was abolished by simultaneous thymidine starvation. It was likewise abolished if amino acid starvation was followed by incubation in the presence of amino acids (without thymidine) and then by irradiation of the cells. Post-irradiation amino acid starvation did not lead to the formation of a shoulder but if combined with thymidine starvation it did. It can be concluded from the results that post-irradiation repair processes are facilitated or promoted if, during the post-irradiation interval DNA synthesis is delayed. This delay represents a compensation of the pre-irradiation increase of cellular DNA-content, taking place during inhibition of proteosynthesis. The post-irradiation administration of caffeine did not abolish the formation of the shoulder induced by pre-irradiation amino acid starvation; on the contrary, it induced its formation even in exponentially growing, irradiated control bacteria. (auth)

15905 INFLUENCE OF IONIZING RADIATION ON ANIMAL VIRUSES. Part II. Dilovski, M. (Akademiya na Selskostopanskite Nauki, Sofia). Zentralbl. Veterinaermed., Reihe B; 20: No. 4, 250-255(Jun 1973). (In German).

The effect of a subiethal dose of gamma rays (5×10^5 R) from ^{60}Co on the multiplication of Aujeszky virus was studied in cultures of chicken fibroblasts. DNA synthesis in the infected cells was studied using ^{3}H-thymidine autoradiography, viral protein by means of immunofluorescence, and formation of virus by determination of the infective titre. It was found that gamma irradiation selectively damaged the viral DNA in that it hindered the formation of infectious virus particles. The immunofluorescence studies showed that there were no changes in the synthesis of viral proteins. L-cysteine at a level of 0.2% prevented the inhibiting activity of the gamma rays if present during irradiation. (GE)

15906 ULTRASTRUCTURAL CHANGES IN EUGLENA AFTER ULTRAVIOLET IRRADIATION. Michaels, A.; Gibor, A. (Univ. of California, Santa Barbara). J. Cell Sci.; 13: No. 3, 799-809 (Nov 1973).

The structural changes associated with the ultraviolet-induced bleaching of light-grown cells of Euglena gracilis were investigated. Light- and electron-microscopic observations of the bleaching process indicated a continuity of plastid structure in cells five generations after receiving a bleaching dose of ultraviolet light. There seemed to be a continuous dilution of the plastid thylakoids and a decrease in plastid size in the bleaching cells. There also seemed to be a change in the position of the plastids in relation to the mitochondria in the bleaching cells. The plastid and possibly the mitochondria were the only organelles affected by the ultraviolet irradiation. The continuity of plastids in bleaching cells of Euglena is discussed in relation to the proposed effect of the ultraviolet light. (auth)

15907 ANOXIC RADIOSENSITIZATION OF TWO BACILLUS SPECIES BY p-NITROACETOPHENONE. Ewing, D. (Inst. of Cancer Research, Sutton, Eng.). Int. J. Radiat. Biol.; 24: No. 5, 505-515(Nov 1973).

P-nitroacetophenone (PNAP) has been tested for its ability to alter radiation sensitivity in two closely related bacilli. PNAP is an anoxic sensitizer of spores and vegetative cells of both B. megaterium and B. pumilus, although the extent of PNAP's sensitization differs in each of the four test systems. In the spores, PNAP increased the anoxic responses by 40% in B. megaterium and 20% in B. pumilus. (The oxygen enhancement ratios here are 2.14 and 2.22, respectively.) In both vegetative cells, PNAP achieved full oxygen-level sensitization, increasing the anoxic responses of B. megaterium by 130% and B. pumilus by 60%. These factor-of-two ratios in PNAP's efficiency in both the spores and vegetative cells suggest this difference might be due to inherent differences in the cells themselves. The ratios of the amounts of DNA in the spores and vegetative cells correspond closely to the ratios of PNAP's maximum efficiencies in these cells. Those results, while not identifying DNA as the target, suggest that specific reactions between PNAP and possible target molecules should be studied. (auth)

15908 SENSITIVITY TO THE LETHAL ACTION OF UV RADIATION IN STAPHYLOCOCCUS AUREUS STRAIN IN RELATIONSHIP TO THE NUMBER OF ITS PROPHAGES. Karska-Wysocki, B.; Sonea, S. (Univ. of Montreal). Rev. Can. Biol.; 32: No. 3, 151-156(Sep 1973). (In French).

The sensitivity to uv irradiation of a non-lysogenic Staphylococcus aureus strain, BSS, is lower than that of the same strain lysogenized with one phage (01 or 47) and much lower than when lysogenized with both phages. Experimental conditions were chosen so that induction was not the main cause of lethality by uv irradiation. Accumulation of prophages by S. aureus seems to be limited by this increased sensitivity to uv of polylysogenic clones. This phenomenon is an example of the general and lasting tendency of prokaryotes to limit the intracellular amount of DNA. (auth)

15909 EFFECTS OF HEAVY IONS ON BACTERIA. Atlan, H. (Univ., Rouen, France). Life Sci. Space Res.; 11: 273-280(1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Genetically well-known bacteria were used to study efficiencies of heavy ions for mutation induction. For space experiments a technique of correlation of tracks of particles (in emulsion stacked on and between Petri dishes) with individual mutations, was designed and checked in balloon flights. No clear cut results could be obtained without previous identification of genetic markers sensitive to irradiation by heavy ions. Accelerator experiments were performed at the Berkeley HILAC for systematic study. The results obtained on a strain of E. coli K12F- requiring threonine, leucine, and arginine showed that the cell inactivation kinetics for gamma rays, helium, carbon, and oxygen ions were almost identical while argon was less effective. Heavy ions up to oxygen were either equally or less efficient than gamma rays for induction of reverse mutations. (IAA)

15910 EFFECTS OF ^{60}Co GAMMA RADIATION ON RICEBRAN OIL. Han, D. B.; Han, G. S.; Yoo, Y. J. Han'guk Sikp'um Kwahakhoe Chi; No. 2, 129-135(1973).

The accumulation of peroxides, acid values, and carbonyl values during irradiation and post-irradiation storage of the ricebran oil was studied. The ricebran oils were irradiated with two doses of 2 and 7 megarads (300 rads/sec) at 23°C. The acid values, peroxide values, and carbonyl values were measured at regular intervals of one week during the storage at 5 and 25°C. During the storage, the acid values of the irradiated ricebran oils increased or decreased insignificantly regardless of the addition of antioxidants and storage temperature. The peroxide values did not increase continuously but increased zigzag. The result was indicated that the composition and decomposition of peroxides occurred continuously throughout the storage. As the peroxide values increased, carbonyl values decreased and changed quite differently, but, especially in the 7th week, they were constant or insignificant. Dibutylhydroxytoluene was more effective than caffeic acid in retarding the formation of peroxides during irradiation of ricebran oils and post-irradiation storage. The effect of antioxidant was more efficient at 2 megarads than at 7 megarads irradiation. In the storage of ricebran oil, the addition of antioxidants after irradiation is more desirable than before irradiation. In spite of changing conditions such as storage temperature and addition of antioxidants, the peroxide values of ricebran oils irradiated at 2 megarads were always greater than those at 7 megarads during the storage. Peroxide values of samples at high temperature (25°C) storage increased twice as much as those of low temperature (5°C) storage samples. At low temperature, peroxide values in the first week increased twice during the period of the 8 weeks storage, but those did from three to four times at higher temperature in the same period. Therefore, the low temperature storage is recommendable too. (Korean Sci. Abstr.)

Radiation Effects on Plants

Refer also to abstracts 15567, 15815, 15817–15819, 15825, 15830, 15835, 15848, 15849, and 15938.

15911 (FRNC-TH-408) EFFECTS OF ACUTE AND SUB-ACUTE GAMMA RADIATION ON PHOTOSYNTHETIC RELEASE AND RESPIRATION OF THREE UNICELLULAR MARINE ALGAE. Ehrhardt, J. P. (Bordeaux-1 Univ., 33 (France)). 1973. 119p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis.

Lethal doses of irradiation are required before a 50% inactivation of the photosynthetic release is achieved. The chloroplasts, after this treatment, are one and a half times more resistant than the nucleus. The delayed effect is irreversible when it corresponds to a dose in excess of that necessary for the immediate 10% inhibition of the photosynthetic release. A decrease is observed in the respiration during several days after the occurrence of an intermediate increase. This behavior may be considered to be a consequence of the irreversible destruction of the mitochondrial sites. (FR)

15912 INDEPENDENT INHERITANCE OF THE NEW CHARACTER "LACK OF ANTHOCYANIN" AND OF THE TYPE OF GENERATIVE BRANCHES IN THE COTTON SPECIES GOSSYPIUM PERUVIANUM (SYN. GOSSYPIUM BARBADENSE). Konoplya, S. P.; Fursov, V. N.; Druzhkov, A. A.; Nuryeva, G. N. (Turkmenian Research Inst. of Fine-Fibred Cotton Breeding, Iolotan, USSR). Genetika; 9: No. 10, 154-156(Oct 1973). (In Russian).

A line of cotton was isolated carrying a new mutation induced by fast neutrons in the variety 5476-I. The mutant plants are characterized by the lack of anthocyanin either in the stem, or in branches, in nodes of leaf nervation, in floral petals. The new mutation is recessive with respect to the presence of anthocyanin and is inherited independently of the type of generative branches. It is proposed to designate the new mutation by the symbol "ant", the symbol "Ant" being proposed for its dominant normal allele (the presence of anthocyanin). (auth)

15913 INFLUENCE OF DOSE, ENVIRONMENTAL CONDITIONS, AND NUCLEAR VOLUME ON SURVIVAL TIMES IN SEVERAL GAMMA-IRRADIATED PLANT SPECIES. Sparrow, A. H.; Schwemmer, S. S.; Bottino, P. J. (Brookhaven National Lab., Upton, NY). Int. J. Radiat. Biol.; 24: No. 4, 377-388(Oct 1973).

A relationship between environmental conditions (light and temperature) and mean survival time (MST) after gamma irradiation has been shown for plant species from six genera (Arabidopsis, Capsella, Chrysanthemum, Raphanus, Tradescantia, and Tropaeolum). A five-fold difference among species in MST after irradiation was found to be directly related to nuclear volume (NV). The regression MST(Y) versus NV(X) has the form log $Y = -0.515 + 0.597 \log X$, and a correlation coefficient of 0.92. An increase of 8°C in temperature after irradiation decreased the MST and reduced survival (by over 50% for Arabidopsis thaliana). Decreased post-irradiation temperature increased the MST and the percentage survival of Arabidopsis and Capsella bursa-pastoris. A correlation between decreasing survival time and increasing dose also was demonstrated for these two species. The importance of allowing sufficient observation time and controlling environmental conditions after irradiation to determine accurate levels of survival and, thereby, the radiosensitivity of plant and animal species is discussed. (auth)

15914 EFFECTIVENESS OF FISSION NEUTRONS, 14.7-MeV MONOENERGETIC NEUTRONS, AND ^{60}Co GAMMA RADIATION ON SEEDLING GROWTH REDUCTION AND INDUCTION OF CHLOROPHYLL-DEFICIENT MUTATIONS IN BARLEY. Conger, B. V.; Constantin, M. J. (UT-AEC Comparative Animal Research Lab., Oak Ridge, TN). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

Experiments with seeds (caryopses) of two barley cultivars (Hordeum vulgare L. emend. Lam. cv. Himalaya and Atlas-57) are described. Growth of Himalaya seedlings from seeds of 2 to 13% water content irradiated in vacuo and soaked in nitrogen-bubbled water at 0°C indicated fission neutrons N_f to be 54 to 60 times more effective than ^{60}Co γ radiation. When seeds were irradiated similarly, but soaked in oxygen-bubbled water at 0°C, the RBE of N_f ranged from 7.6 at 2.2% to 60 at 13.0% water content. At 32% water, seeds became more radiosensitive but proportionally more so to γ radiation, therefore the RBE of N_f decreased to 7.5. Germinated seeds (24 hr.) were slightly more radiosensitive than dormat seeds of 32% water content and the RBE of N_f was 6.8. The change in RBE of N_f with changing seed water content and/or oxygen availability is caused by the greater effect of these factors on the modification of γ-radioinduced damage. The results are discussed in terms of direct versus indirect mechanisms of radiation action. In seeds of 13% water, 14.7 MeV neutrons were slightly less effective than N_f in reducing seedling growth of both Atlas-57 and Himalaya. Both neutrons were 50 to 60 times more effective than γ radiation. The Atlas-57 cultivar was more sensitive to all three radiations than Himalaya. For the chlorophyll-deficient mutation studies, seeds of Atlas-57 were adjusted to a water content of 13% and irradiated with varying doses of ^{60}Co γ radiation, N_f, and 14.7 MeV neutrons. Mutagenic effectiveness of N_f was higher than 14.7 MeV neutrons but both neutrons were much more effective than γ radiation. The RBE's for mutations per 1,000 M_2 seedlings per rad $\times 10^{-2}$ were 73.2 and 132.2 for 14.7 MeV neutrons and N_f, respectively, compared to γ radiation. Mutagenic effectiveness, calculated on an M_2 seedling basis was independent of dose for all radiations. Mutagenic efficiency computed on the basis of the frequency of mutations per 1,000 M_2 seedlings versus percentage reduction in M_2 seedlings per spike showed that ^{60}Co γ rays may be more efficient than either of the two types of neutrons. (GE)

15915 NUTRITIONAL STATUS AND RADIOSENSITIVITY OF SOME CICER ARIETINUM L. CULTIVARS. Mujeeb, K. A.; Siddiqui, S. H. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Experientia; 29: No. 11, 1426-1428(15 Nov 1973).

Seeds of three cultivars of chickpeas were analyzed for protein content, amino acid composition, and essential total amino acid ratios. The three varieties of seeds were exposed to gamma radiation in doses of 2.5 to 25 kR at a dose rate of 70 R/min. The seeds were then planted and maintained under laboratory conditions. Seed germination and seedling height were observed for 14 days and results were tabulated. The significance of the data for the development of a mutation breeding program is discussed. (HLW)

15916 MODIFYING EFFECT OF GIBBERELLIN AND ETHYLENIMINE AFTER IRRADIATION OF SEEDS OF VICIA FABA WITH GAMMA RAYS. Dryanovska, O. A.; Nguen Thi Thuan. (Central Lab. of General Genetics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 8, 1089-1091(1973).

The action of ethylenimine as a mutagenic agent was compared with that of gibberellin upon their combined utilization with γ rays in Vicia faba. Gamma radiation alone produced the greatest percentage of cells with chromosomal aberrations at both 5 and 10 kR doses. The addition of ethylenimine reduced the percentage below that of γ rays alone but was still higher than for ethylenimine alone. The same relationship was true for gibberellin but to a lesser extent. (ERB)

15917 RADIATION SENSITIVITY OF POLYPLOID WHEATS. Muradyan, A. A.; Avakyan, V. A. (Lab. of Induced Mutagenesis in Plants, Erevan). Biol. Zh. Arm.; 26: No. 4, 56-61(Apr 1973). (In Russian).

A comparative study of the radiation sensitivity of polyploid wheats showed a high sensitivity of diploid wheats to radiation in relation to germination, viability, plant growth, and seed production. Tetraploid wheats did not differ in radiation sensitivity from hexaploid. (tr-auth)

15918 MODIFICATION OF BARLEY SEED RADIOSENSITIVITY BY POST-TREATMENT WITH CAFFEINE. I. Effect of Post-Irradiation Heat Shock and Nature of Hydration. Kesavan, P. C.; Trasi, S.; Ahmad, A. (Univ. of Delhi). Int. J. Radiat. Biol.; 24: No. 6, 581-587(Dec 1973).

Barley seeds (3.6% moisture content) were irradiated in vacuo with 45 krads of gamma rays and were then subjected to treatments such as wet heat shock (at 60°C for 90 sec) or oxygenated or oxygen-free hydration (at 0 to 2°C for 13 hours) in the presence or absence of caffeine. A combination of heat shock and oxygen-free hydration was found to be most protective against the post-irradiation oxygen-dependent damage (scored as seedling-injury and chromosomal aberrations). The presence of caffeine in oxygenated water prevented part of the oxygen-enhanced damage; however, the magnitude of such protection decreased after a wet heat shock to the seeds. On the other hand, caffeine counteracted the protective action of oxygen-free hydration, the role of heat shock, in this case, being to accentuate further the caffeine-induced radiosensitization. It is pointed out that the data implied that the reactivity of caffeine towards the gamma-induced intermediate and end-products under oxic and anoxic conditions could be very different, and that the manner of influence of heat shock on the caffeine effect in the irradiated seeds remains to be elucidated. (auth)

15919 RADIOSENSITIVITY OF SEEDS. Pesina, K. (Ustav Experimentalni Botaniky, Prague); Srb, V. Biol. Listy; 38: No. 1, 54-66(Feb 1973). (In Czech).

The radiosensitivity of seeds is reviewed with respect to intrinsic factors acting in the seed. From the systems point of view, radiosensitivity of a species is primarily determined by the interphase volume of the nucleus. Differences in sensitivity in lower taxons seem to be dependent mainly on genetic factors

of a polygenic character. The actual mechanism of radiation damage is determined by interaction of free radicals formed and oxygen controlled by water molecules. For a given dose, radiation damage may vary according to the amount of water available for chemical reactions. The biological damage of seeds does not represent a simple physico-chemical process. Its individual components may either be interrelated or independent. The degree of biological damage by ionizing radiation seems to be time dependent. Barley seeds were used in most experimental efforts. Even though the general validity of the results was confirmed by experiments using other species, differences can nevertheless be expected for seeds having a different germination physiology. (INIS)

Radiation Effects on Animals

Refer also to abstract 15366.

Man

Refer also to abstracts 15580, 15592, 15651, 15900, 16062, 16092, 16451, 17477, 17490, 17688, 17940, 17941, and 17946.

15920 (INIS-mf-914, pp 16-28) RADIATION BURDEN OF THE POPULATION DUE TO MEDICAL APPLICATIONS. Seelentag, W. (World Health Organization, Geneva). 1973. (In German).

From information meeting on the general radiation burden of modern man; Zurich-Oerlikon, Switzerland (23 Mar 1973).

Radiation doses of the population due to medical applications are about 10 to 50% of the natural radiation doses. A survey was made of statistical values of radiation burden caused by x-ray diagnosis. The mean values of the genetically significant dose are different from country to country and from hospital to hospital. They vary from 0.01 up to 1.2 mrad per investigation. The high values arise from insufficient training of the personnel and from bad techniques, especially from the use of poorly adjusted instruments. This indicates that with adequate information the medical radiation burden can be reduced considerably. (INIS)

15921 (INIS-mf-914, pp 64-85) LIMITS OF THE RADIATION BURDEN. Jacobi, W. (Gesellschaft fuer Strahlenund Umweltforschung mbH, Neuherberg/Munich, Ger.). 1973. (In German).

From information meeting on the general radiation burden of modern man; Zurich-Oerlikon, Switzerland (23 Mar 1973).

Recently obtained knowledge shows that in the past for small radiation doses genetic effects had been overestimated whereas somatic late effects had been underestimated, the latter concerning especially cancer and leukemia. A definition of the radiation risk is given and its relation to the received radiation dose for whole-body irradiations is considered, taking account of investigations of survivors of Hiroshima, and Nagasaki and of persons who received high radiation doses for medical reasons. The starting point of the considerations about the limits of whole-body irradiation is the natural radiation dose producing a spontaneous radiation risk, and it is concluded that the maximum radiation dose of 170 mrem/a (recommended by the ICRP) for the entire population actually does not lead to a statistically significant augmentation of cases of cancer. (INIS)

15922 ASPECTS OF RADIOPROTECTION WHICH CONCERN THE SAFEGUARD OF THE PUBLIC. Recht, P. (Commissione delle Comunita Europee, Luxemborg). pp 221-229 of Nuclear Energy and the Environment. Rome; Comitato Nazionale Energia Nucleare (1973). (In French).

From proceedings of the 17th nuclear congress; Rome, Italy (23 Mar 1972). See CONF-720356-.

The fears of the public with respect to nuclear installations are summarized and the safety record of the nuclear industry is stressed. The need for a public relations approach to satisfy the public on the safety of nuclear installations is indicated. The energy needs of the world and the place of nuclear energy in filling that need is discussed. (JSR)

15923 DECREASE OF THE RADIATION LOAD IN HUNGARY OF THE WORKERS IN THE X-RAY DEPARTMENTS DURING THE LAST 30 YEARS. Bozoky, L. Magy. Radiol.; 25: No. 5, 285-288 (Oct 1973). (In Hungarian).

Using special equipment and with the strict observation of the recommendations for protection against radiation injury, the radiation load of the x-ray staff could be considerably diminished in the author's department. By careful observance of the pertinent recommendations essentially lower dose loads could be assured for the Hungarian health workers than the level abroad in general. (auth)

15924 RADIATION-INDUCED SMALL BOWEL INJURY FOLLOWING TELECOBALT THERAPY OF BLADDER TUMOR. Nummi, P.; Tiitinen, J.; Maehoenen, H. (South Saimaa Central Hospital, Lappeenranta, Finland). Scand. J. Urol. Nephrol.; 7: No. 1, 30-32(1973).

Five surgically treated cases of radioinduced injury of the small bowel, of a series of 34 patients with bladder tumor irradiated with telecobalt, are described. The onset of the symptoms was relatively acute. The radiation-induced injury of the terminal part of the small bowel can often be observed by roentgenography even before the onset of subjective symptoms. The treatment consists of resection of the injured part of the intestine. (auth)

15925 LATE INJURIES OF THE SMALL INTESTINE FOLLOWING RADIOTHERAPY FOR UTERINE CARCINOMA. Joelsson, I.; Raef, L. (Dept. of Gynecology, Radiumhemmet, Stockholm). Acta Chir. Scand.; 139: No. 2, 194-200(1973).

A retrospective analysis of patients operated because of stenosis of the small bowel was performed. Patients with a history of radiation treatment of uterine carcinoma at Radiumhemmet were collected. A minimum approximation of the incidence of obstruction of the small intestine following combined intracavitary and external therapy of carcinoma of the uterine cervix seems to be 0.5%. The characteristics of the radiation therapy, the symptomatology of the complications, the surgical procedure, the findings at histologic examination of the tissue specimens, and the clinical course of the patients are all described. It is concluded that surgical intervention because of a limited, radiation-induced stenosis of the small intestine is compatible with a good prognosis. (auth)

15926 SIMPLE METHOD OF DOSAGE CALCULATION IN ROTATION THERAPY. Ueda, T.; Kimura, C. (Aichi Cancer Center, Nagoya, Japan). Nippon Hoshasen Gijutsu Gakkai Zasshi; 28: No. 1, 55-58(Jun 1972). (In Japanese).

In case of rotation therapy, the first step for the estimation of central axis dose is to obtain the tumor skin distance every 10 to 20 degrees around the patient contour. Then tissue-air ratio corresponding to each distance can be read from the ready-made T.A.R. table. These are summed and averaged. In practice, however, the method is somewhat tedious and time-consuming, which is a disadvantage in a busy department. A rapid and simple method to obtain the average tumor-skin distance in case of rotation therapy of the patient with carcinoma of uterine cervix is described. Fifty samples were randomly drawn from a group of carcinoma of uterine cervix that has been receiving radiation therapy. Their contour, antero-posterior, and lateral dimensions were analyzed. If the antero-posterior and lateral dimensions of the patient are measured, the average skin-tumor distance can be calculated from a graph based on the equation obtained from the 50 patients. The difference of dosage calculation between the method of averaged T.A.R. and this simple method was 2% at the most. (auth)

15927 ROLE OF COMPUTER IN THE RADIOTHERAPY OF THE HEAD AND NECK CANCER. Matsuura, S. (National Cancer Center, Tokyo). Nippon Jibi Inkoka Gakkai Kaiho; 76: No. 1, 21-38(Jan 1973). (In Japanese).

In the radiotherapy of the head and neck cancer, the calculation of radiation dose and the planning of treatments have been in practical use, making the best use of the characteristics of analog and digital computer. Particularly, Theracom 1 system developed from NEAC 3100 computer was the complete system to manage the informations on practical treatment. The following are achieved by the computer: The complicated calculation of radiation dose in the case using many radioactive sources is performed in a short time, and the radiation dose distributions on many desired planes are rapidly examined (interstitial radiation of the cancer of the tongue and intra-cavitary radiation of the cancer of the upper jaw). The treatment with radioactive sources and the external irradiation are easily combined, and directly after the region, which lacks of absorbed dose, is found, the necessity of the addition of irradiation for the region is suggested and additional irradiation can be carried out (combined case of interstitial and external irradiation of the cancer of the tongue). In multifield irradiation, the treatment planning with proper radiation dose distribution is made in consideration of the protection of the important organs (eyeshield in the cancer of the upper jaw, shield of the spinal cord in the cancer of the nasopharynx). Any integral dose according to each dose level is calculated under various irradiation methods, and it contributes to the analysis of the effects of treatment according to irradiation methods (single field, two opposing fields, and right angled and wedged two fields irradiation of the cancer of the pharynx). It became possible by the preparation of a file system of personal history to collect and record the treatment results according to regions and to offer the informations on the results of radiotherapy when necessary. (JA)

15928 RADIOTHERAPY OF EPIPHARYNGEAL TUMOURS. II. Gauwerky, F.; Frommhold, H. (Allgemeines Krankenhaus St. Georg, Hamburg). Strahlentherapie; 146: No. 2, 125-139 (1973). (In German).

A standardized target volume for curative and post-operative radiotherapy was constructed on the basis of a study about the topographic-anatomical propagation and the clinical course of more than 100 malignant tumors of the epipharynx. Eleven possible and practiced irradiation plans were tested with regard to the recording of the standardized target volume, the care of the critical organs cervical medulla and eye, and the inevitable integral dose. The thinkable optimization criteria were critically evaluated in relation to this tumor localization. Neither the problems of irradiation rhythm and height of the individual nor of total dose are the object of this investigation. (auth)

15929 ENVIRONMENTAL AND FALLOUT GAMMA RADIATION PROTECTION FACTORS PROVIDED BY CIVILIAN VEHICLES. Burson, Z. G. (EG and G, Inc., Las Vegas, NV). Health Phys.; 26: No. 1, 41-44(Jan 1974).

Environmental and fallout gamma radiation protection factors (PF's) were estimated for a variety of civilian transportation vehicles using measurements of the natural terrestrial radiation as a source. The PF values are below 2 in light vehicles, truck beds, or trailers; from 2.5 to 3 in the cabs of heavy trucks and in a railway guard car; and from 3.0 to 3.5 in the engineer's seat of heavy locomotives. This information can be useful in planning the possible movement of personnel from or through areas contaminated either by a wartime incident or a peacetime accident. The information may also be useful for studying the reduction of exposure to the natural terrestrial radiation environment provided by vehicles. (auth)

15930 IONIZING RADIATION. pp 40-42 of Norway's National Report to the United Nations Conference on the Human Environment. Oslo; Royal Ministry of Foreign Affairs (1972).

From United Nations conference on the human environment; Stockholm, Sweden (5 Jun 1972).

General statements are made on measures to protect personnel, patients, and public from ionizing radiation. A brief survey of the extent and effects of radioactive fallout is given. It is stated that no radioactive wastes from the two operating Norwegian reactors or other Norwegian sources have been dumped or discharged into the open sea. The use of radioactive materials in industry, research, and medicine is subject to control. Natural radioactivity in the atmosphere and in mines is being investigated. An emergency organization has been set up to reduce the effects of contamination from nuclear tests or reactor accidents. Measures to supervise discharge from ship and power reactors and other sources must be taken during the next decade. (NO)

15931 CHROMOSOME ABERRATIONS IN PERSONS ACCIDENTALLY EXPOSED TO ^{192}IR GAMMA RAYS. Ishihara, T.; Kohno, S.; Hirashima, K.; Kumatori, T.; Sugiyama, H. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 3, 328-335(Sep 1973).

Chromosome examinations were made both in cultured peripheral lymphocytes and in freshly aspirated bone marrow cells of 6 persons accidentally exposed to gamma rays from ^{192}Ir. Samples of peripheral blood for the chromosome analysis were repeated mostly at weekly intervals during the hospitalization beginning 10 to 11 days after the initial exposure, and at more prolonged intervals after that period. The average yield of dicentrics plus rings in peripheral lymphocytes ranged from 0.0015 to 0.1367 per cell. The chromosome abnormalities, mostly of the stable-type rearrangements of chromosomes, were observed in bone marrow from two of the 6 cases. Based on the aberration yield in peripheral lymphocytes, the average total body absorbed dose was estimated to be equivalent to 9.8 to 124 rad of ^{60}Co gamma rays and 15.6 to 152 rad of high energy x-rays. When the dose estimate was made with the $Q_{\bar{d}}$ value, the average total body absorbed doses were higher than those obtained by direct extrapolation of the aberration yield. This seemed to result from non-uniformity of the exposure. (auth)

15932 BIOCHEMICAL ANALYSIS OF SOME METABOLITES IN URINE AND BLOOD IN PERSONS EXPOSED ACCIDENTALLY TO A SOURCE OF ^{192}IR. Nakamura, W.; Mizobuchi, K.; Sawada, F.; Kankura, T.; Kobayashi, S. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 3, 304-319 (Sep 1973).

Eleven biochemical indicators (5-hydroxyindoleacetic acid, xanthurenic acid, creatine, creatinine, β-aminoisobutyric acid, taurine, 11-deoxy-17-ketosteroid, total estrogens and Dische reaction-positive substance(s) in urine; 5-hydroxytryptamine in whole blood; and cortisol in blood plasma) of the "radiation injury" were analyzed in 6 cases which were accidentally exposed to a gamma ray source of ^{192}Ir. Among them, 4 indicators including 5-hydroxyindoleacetic acid, taurine and Dische reaction-positive substance(s) in urine and 5-hydroxytryptamine in whole blood reflected the severity of the injury to some extent for long period far after the exposure: Urinary excretion of 5-hydroxyindoleacetic acid was less than that of non-irradiated persons from days 11 to 17 after the exposure and increased to several times more than those of the non-irradiated in the subsequent week (days 17 to 25). Blood levels of 5-hydroxytryptamine were minimal at the day 24th after the exposure in the 2 cases (S. H. and Y. S.) which were exposed to higher doses. The ratio of urinary taurine over alanine remained high in the two higher dose cases for several weeks of the post-irradiation period and returned to normal level thereafter. The ratio of Dische reaction-positive substance(s) to creatinine in urine was high in the same two cases during 8 to 13 weeks of the post-irradiation. (auth)

15933 HEMATOLOGICAL STUDIES OF SIX CASES OF ACCIDENTAL EXPOSURE TO AN IRIDIUM RADIOGRAPHIC SOURCE. Hirashima, K.; Ishihara, T.; Kumatori, T.; Sugiyama, H.; Kurisu, A. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 3, 287-296(Sep 1973).

Among six persons (male, age 20 to 30) exposed accidentally to ^{192}Ir gamma rays, five cases showed hematopoietic disorders of various degrees. One case (S. H. 25 Yr.) showed a severe hematopoietic injury such as pancytopenia between the 3rd and 7th week after the initial exposure. At the 4th and 5th week, the thrombelastogram showed significant improvement, followed by increase of leukocyte and platelet counts. This clinical test was useful for diagnosis and prognostic evaluation in this crucial pancytopenic period during which some treatment was needed. He was treated only with a prophylactic administration of antibiotics in an isolated clean aseptic room. After the 5th week, the hematopoietic disorders were rapidly improved although the leukocyte counts still remained at a subnormal level for more than 18 months. The other 4 cases showed various degrees of temporal leukopenia and hypoplasia of bone marrow, while neither anemia nor thrombocytopenia was observed. From the severity of hematopoietic disorders, a dose delivered to hematopoietic organs of S. H. was estimated to be between 200 and 400 rad. This was different from a cytogenetically estimated dose of 124 rad. The difference may mainly reflect a difference of doses received between hematopoietic cells and of peripheral circulating lymphocytes, which might result from a different distribution of these cells in the body and from a non-uniform gamma-irradiation of ^{192}Ir source. (auth)

15934 EFFECT OF CH_3-B_{12} (CAROMIDE-ME) ON CANCER PATIENTS UNDER RADIOTHERAPY. Onoda, T. Shinyaku To Rinsho; 22: No. 7, 1311-1313(Jul 1973). (In Japanese).

The effect of vitamin B12 was examined in 20 female patients with malignant tumor during radiotherapy using CH_3-B_{12} (caromide-me). Those patients were compared with patients for whom the drug was not used. A total of 20 intramuscular injections of 500 g of caromide-me were performed. Measurement of body weight, blood tests, and serologic tests were performed prior to the use of caromide, after 10 injections, and within one week of the completion of 20 injections. The control group consisted of patients treated with ^{60}Co for the past two years selected randomly. The state of their blood was examined prior to treatment and two months later for comparison. The group treated with caromide showed little decrease in the body weight, red blood cell count, hemoglobin, white blood cell count, and LDH value. Although there was no difference in the platelet count or serum protein, the values of GOT and GPT tended to rise. Compared with the control group the caromide injection group was also compared with a radiotherapy group having a similar extent of the progress of the same disease. In the caromide injection group, there was hardly any decrease in the red blood cell count; the decrease of serum protein was $\frac{1}{3}$ of that of the control group, and the hemoglobin value was rather satisfactory. No difference was observed in the white blood cell count, platelet count, GOT value, or GPT value between two groups. Observations during the period of injections and the subsequent two months revealed no side effect of the intramuscular injection of caromide-me. (JA)

15935 DOSE ESTIMATION OF NON-OCCUPATIONAL PERSONS ACCIDENTALLY EXPOSED TO ^{192}IR GAMMA RAYS. Hashizume, T.; Kato, Y.; Nakajima, T.; Yamaguchi, H.; Fujimoto, K. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 3, 320-327(Sep 1973).

Six persons were accidentally exposed to gamma rays from an ^{192}Ir source. Since they were non-occupational persons, a means to estimate the absorbed dose was needed to be established. As three of them wore wrist watches when they were exposed to gamma rays from the ^{192}Ir source, cumulative doses of three

persons could be estimated by measuring a thermoluminescence from jewels(ruby) of their watches. The absorbed doses of the six persons were also estimated through reconstructing timetables of the six persons in relation to the ^{192}Ir source. The doses estimated with reference to the thermoluminescence for three persons were in good agreement with those obtained only through reconstruction of their movements without referring to the thermoluminescence data. This indicates that the absorbed doses of the three others without the use of the thermoluminescence data were probably close to what they received. The thermoluminescence method proved to be a very useful one for dose estimation of persons accidentally exposed, if they wear wrist watches and to be far quicker in estimating the absorbed dose than the meticulous reconstruction of timetables. (auth)

15936 ACHILLES TENDON REFLEX AND AGING IN ATOMIC BOMB SURVIVORS, HIROSHIMA. Omori, Y.; Ashley, F. W.; Belsky, J. L. (Atomic Bomb Casualty Commission, Hiroshima). Hiroshima Igaku; 25: No. 9, 1079-1092(Sep 1972). (In Japanese).

The relationship between the achilles tendon reflex, aging, and radiation was examined with the photomotograph in 2396 atomic bomb survivors and non-survivors. The subjects consisted of a normal control group with 2100 persons aged 18 to 89 and the group with either mild diabetes mellitus (117 persons), disease of nervous and muscular system (100), history of thyroid dysfunction (61) or other diseases (18). The reflex time of the achilles tendon in the normal control group increased significantly with age, and it was more delayed in woman than in man. The mean time from stimulation to $\frac{1}{2}$ relaxation in normal subjects was 290 ± 49 msec (average age, 46) in man and 321 ± 49 msec (average age, 46) in woman, and the values were the same as reported in Europe and America. Statistically significant differences were not found between exposure, obesity, and reflex time. No significant difference was found in mean reflex time. No significant difference was found in mean reflex time between normal group and the group with diseases. The reflex time of each group with diseases seemed to increase with age; however, it was not statistically significant. Absence of reflex was found mainly in the cases with diabetes mellitus (22.4%), and the frequency was especially high in the advanced aged both of the group with diabetes mellitus and normal group (3.2%). It was more precise and useful to use the time of stimulation to $\frac{1}{2}$ relaxation than contraction time and $\frac{1}{2}$ relaxation time, when the achilles tendon reflex was applied to aging test. (JA)

15937 DEVELOPMENT OF LYMPHOPENIA IN UREMIC PATIENTS UNDERGOING EXTRACORPOREAL IRRADIATION OF THE BLOOD WITH PORTABLE BETA UNITS. Weeke, E. (Rigshospitalet, Copenhagen). Radiat. Res.; 56: No. 3, 554-559 (Dec 1973).

A prototype of a portable $^{90}Sr/^{90}Y$ irradiator for extracorporeal irradiation of the blood (ECIB) is described. Eight patients with chronic uremia received median transit doses of 14 to 57 rads during an average of 160 hr continuous ECIB. In all patients the lymphocyte concentration remained around 50 to 60% of the pre-ECIB value during the following 200 days of observation. When these results are compared with the development and degree of lymphopenia in patients receiving higher transit doses (100 to 500 rads), a dose-response effect seems likely. The construction of a portable beta unit that can be used in the clinic without any risk of exposure is only compatible with the use of sources that deliver very low transit doses. The duration of treatment required to significantly deplete the entire lymphoid mass using such minimal transit doses would, however, be prohibitive. (auth)

15938 BIOLOGICAL EFFECTS OF RADIATION. Coggle, J. E. London: Wykeham Publications Ltd. (1971). 149p. pounds 2.00.

An introduction to the subject, dealing with the following aspects: properties of ionizing radiation; effect of radiation at the molecular and subcellular levels; radiation cell survival in vivo; cellular and genetic effects; effects at tissue level; factors modifying the biological effect of radiation; cancer; lifeshortening; radiation hazards and standards for radiation protection. There is a short glossary. (Occup. Saf. Health Abstr.)

15939 DOSE LIMITS AND SOCIAL INSURANCE. Fischerhof, H. (1973). vp. (In German).

From 1st international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The problems of the indemnification of professional radiation injuries are discussed which postulate a further development of the social insurance law in the FRG. This could be possible by means of a legal new regulation or a modification of the 7th Occupational Disease Ordinance by introducing typical radioinduced diseases or by a special jurisdiction. (GE)

15940 NUCLEAR POWER PLANTS: HEALTH AND SAFETY. Oslo; Statens Institutt for Straalehygiene (1973). 22p. (In Norwegian).

A popular survey is given of the natural and man-made radiation sources and the effects of ionizing radiation on man. The principles of radiation protection are presented and a brief survey of the radiation hazards from nuclear power plants given. Radioecology and critical populations are also briefly treated and the limits for releases of radioactivity and the ICRP maximum permissible doses explained. The surveillance of nuclear power plants and reactor safety and accident situations are outlined. (NO)

15941 CINEROENTGENOTHERAPY OF THE PARAMETRIA AND OF THE LYMPHATIC EXCRETORY PELVIC REGION BY ULTRAHARD X RAYS. Nemeth, G.; Fournier, D. V.; Kuttig, H. (Univ., Heidelberg). Strahlentherapie; 146: No. 2, 166-173(1973). (In German).

A report is given with regard to the possibilities of cineroentgenotherapy of the parametria and of the lymphatic excretory pelvic region by ultrahard x rays of the 42 MeV betatron. During an iliac pendulum irradiation, the dose distribution can be adjusted to the course of the iliac lymphatic excretory region by grouping the pendulum axes in a cranially convergent manner; herein, the dose maxima, first being separated, are coinciding completely in the height of the aortal bifurcation. The use of the method, combined with local radium therapy, and the radiation dose to the adjacent organs are discussed. (auth)

15942 IMPORTANCE OF DIAGNOSTIC DOSIMETRY IN RESPECT TO THE RADIOLOGIST'S PROTECTION. Luzsa, G.; Bojtor, I.; Koczkas, G. Magy. Radiol.; 25: No. 5, 289-294(Oct 1973). (In Hungarian).

The radiation doses reaching the body surface of patients, in whom thoracic oesophagus, and gastric x ray examinations have been performed, were measured with Diamentor diagnostic dosimeter. From the time and the doses given conclusions are drawn in respect to mean diaphragm aperture. The radiation exposures of the patients have been compared with the data of various authors. The use of Diamentor is recommended in order to control the radiologist's radiation protection in objective manner. Thus considerable development of the radiation protection may be obtained. (auth)

15943 PATIENT EXPOSURES IN DIAGNOSTIC RADIOLOGY: PROTECTION PROBLEMS OF CURRENT CONCERN. J. Belge Radiol.; 56: No. 5, 467-469(1973).

Publications 15 and 16 of the ICRP concerning the protection of patients during diagnostic x-ray radiography are discussed in some detail. Changes in the frequency and types of x-ray examinations warrent the wide dissemination and implementation of the recommendations and principles stated in the publications. Methods of dose reduction are of paramount concern and are detailed in the publications. (ERB)

15944 DISTRIBUTION OF ABSORBED DOSES IN THE ORGANS OF PATIENTS IN X-RAY DIAGNOSIS. Telichko, F. F. Med. Radiol.; 18: No. 10, 36-44(Oct 1973). (In Russian).

A dosimetric method was used to determine absorbed doses in the organs located at different depth in the area of direct irradiation in roentgenodiagnostic procedures. The author gives a total of 1500 dosimetric parameters characterizing absorbed doses in the tissues of the critical organs of patients at various voltage (50 to 100 kV), filtration (0 to 10 mm Al), SFD (40 to 100 cm) and the area of irradiation (100 to 1200 cm^2), and also mean values of coefficients permitting to determine absorbed doses in the tissues under definite conditions of investigation. Results of investigation serve as a prerequisite for optimal specifications and methods of x ray examinations. (auth)

15945 EXCRETION OF 5-HYDROXYINDOLEACETIC ACID IN PATIENTS IRRADIATED THERAPEUTICALLY. Pericic, D.; Deanovic, Z. (Rudjer Boskovic Inst., Zagreb). Int. J. Radiat. Biol.; 24: No. 5, 443-448(Nov 1973).

The 24-hr urinary excretion of 5-hydroxyindoleacetic acid (5-HIAA) was determined in patients suffering from genital carcinoma, who had been irradiated therapeutically with γ rays from intracavitary radium sources and/or with x rays. Radium was applied for 46 hrs, twice within two weeks. X radiation was delivered on two anterior and two posterior abdominal fields, 800 R daily in the source of 15 days. The values of 5-HIAA obtained in periods of irradiation were compared with control values (before irradiation) in the same patients. Creatinine was also determined. In most patients treated with radium, there was a depression in 5-HIAA excretion only during the treatment; after removal of the radium, there was a slight increase. The excretion of creatinine in these patients was not constant. The increased urinary 5-HIAA excretion was observed also in three out of five x-irradiated

patients. The results are discussed with regard to the data published previously. (auth)

15946 CZECHOSLOVAK BIBLIOGRAPHY ON INDUSTRIAL HYGIENE AND OCCUPATIONAL DISEASES, 1972. Volume 17. Prague; Institute of Hygiene and Epidemiology (1973). 179p.

A bibliography of 233 references with abstracts of each is presented under the following headings: general aspects and organization of occupational health; physiology of work and ergonomics; biological aspects of harmful exposures; occupational diseases; and methods and apparatus. Under each main heading there are some references to studies on radiation hazards of nuclear reactors, x-ray therapy, and uranium mines, as well as radiation diseases and their treatment. Author and subject indexes are included. (HLW)

15947 INDEX RADIOHYGIENICUS. Volume 14, No. 1, March 1972. Bibliography, Keyword Index, Author Index. Prague; Institute of Hygiene and Epidemiology (1972). 178p.

A bibliography of world literature on radiation hygiene and biological effects of ionizing radiation is presented. (947 references) (Nucl. Sci. Abstr. Czech.)

15948 INDEX RADIOHYGIENICUS. Volume 14, No. 2, April 1972. Bibliography, Keyword Index, Author Index. Prague; Institute of Hygiene and Epidemiology (1972). 179p.

A bibliography of world literature on radiation hygiene and biological effects of ionizing radiation is presented. (971 references) (Nucl. Sci. Abstr. Czech.)

15949 INDEX RADIOHYGIENICUS. Volume 14, No. 3, May 1972. Bibliography, Keyword Index, Author Index. Prague; Institute of Hygiene and Epidemiology (1972). 145p.

A bibliography of world literature on radiation hygiene and biological effects of ionizing radiation is presented. (768 references) (Nucl. Sci. Abstr. Czech.)

15950 INDEX RADIOHYGIENICUS. Volume 14, No. 4, June 1972. Bibliography, Keyword Index, Author Index. Prague; Institute of Hygiene and Epidemiology (1972). 93p.

A bibliography of world literature on radiation hygiene and biological effects of ionizing radiation is presented. (998 references) (Nucl. Sci. Abstr. Czech.)

15951 INDEX RADIOHYGIENICUS. Volume 14, No. 5, June 1972. Prague; Institute of Hygiene and Epidemiology (1972). 335p. (In Czech).

Author and keyword indexes cumulated from the previous four issues of the volume are presented. (Nucl. Sci. Abstr. Czech.)

15952 INDEX RADIOHYGIENICUS. Volume 15, No. 1, September 1972. Prague; Institute of Hygiene and Epidemiology (Sep 1972). 188p. (In Czech).

A bibliography of world literature on radiation hygiene and biological effects of ionizing radiations is presented. (999 references) (Nucl. Sci. Abstr. Czech.)

15953 INDEX RADIOHYGIENICUS. Volume 15, No. 2, October 1972. Prague; Institute of Hygiene and Epidemiology (1972). 171p. (In Czech).

A bibliography of world literature on radiation hygiene and biological effects of ionizing radiations is presented. (888 references) (Nucl. Sci. Abstr. Czech.)

15954 OSTEOGENOUS SARCOMATA INDUCED BY IRRADIATION. Kolar, J. (Karlova Univ., Prague); Bek, V.; Kolinova, E. Cesk. Radiol.; 27: No. 1, 69-72(Jan 1973). (In Czech).

The occurrence of osteogenous sarcomata as a result of therapeutic irradiation is discussed. Two cases are reported confirming the carcinogenic effect of ionizing radiation: osteoplastic sarcomata formed as a result of radiotherapy of retinoblastoma and of Wilms' tumor, respectively. The second case is believed to be the fifth reported case in the world of the sarcoma resulting from the radiotherapy of nephroblastoma. (INIS)

15955 CZECHOSLOVAK BIBLIOGRAPHY ON INDUSTRIAL HYGIENE AND OCCUPATIONAL DISEASES, 1971. Volume 16. Prague; Institute of Hygiene and Epidemiology (1972). 151p.

A bibliography of 210 references with abstracts of each is presented under the following headings: general aspects and organization of occupational health; biological effects of occupational hazards; diseases due to occupational hazards and treatment of occupational diseases; occupational physiology and psychology; and methods and apparatus. Under each main heading there are some references to studies on radiation hazards of nuclear reactors, x-ray therapy, and uranium mines, as well as radiation diseases and their treatment. Author and subject indexes are included. (HLW)

15956 RADIATION PROTECTION. Trnovec, T.; Minarik, F.; Kollar, J.; Fojtik, M.; Uhrik, F.; Nikodemova, D.; Hrabovcova, A. Bratislava; Praca-vydavatel'stvo SROZ (1970). 123p. (In Slovak).

A manual for the safe handling of ionizing radiation is presented discussing, in several chapters, individual aspects of the protection of man against radiation. Dealt with are the biological effects of radiation, protection during work with x-ray sources and sealed radioactive sources, and safety measures in work with unsealed sources. In a brief review, dosimetric instruments, their principles, and commonly used equipment are described including equipment used in laboratories and plants in Czechoslovakia. In addition, protective neutron dosimetry and specific problems of work safety in betatron operation are presented. The concluding chapter discusses Czechoslovak standards and regulation. (Nucl. Sci. Abstr. Czech.)

15957 INTEGRAL ABSORBED DOSE IN RELATION TO RADIOPROTECTION. Bercy, A. J. Belge Radiol.; 56: No. 5, 451-455(1973). (In French).

Concrete examples are used to show the easy way of calculating the integral absorbed dose in radiotherapy, radiography, and also in curietherapy. The knowledge of this integral absorbed dose enables the less dangerous to be chosen for the patient among two irradiation techniques. The integral dose absorbed by a radiologist, by a technician handling radiography or radiocobalt apparatus is also calculated. (auth)

15958 ACTION OF CYSTAMINE UPON CYTOGENETIC CHANGES IN THE PERIPHERAL BLOOD LYMPHOCYTES IN PATIENTS SUBJECTED TO TELEGAMMA THERAPY. Berlin, L. B.; Baryshnikova, N. M.; Belkin, P. I.; Karginova, T. Kh.; Karulina, T. V.; Konstantinova, G. V.; Meshcheryakova, N. P.; Museichuk, E. Ya.; Nikitina, M. P.; Lukina, K. G.; Savina, A. A.; Khieninson, A. S.; Chen, T. P.; Sharkova, Zh. M. (City Oncological Dispensary, Leningrad). Vop. Onkol.; 19: No. 10, 68-73 (1973). (In Russian).

Using a metaphase analysis, chromosome aberrations in peripheral blood lymphocytes were studied in 81 oncogynecological patients after 1, 3, 6, 11 to 12 and 16 to 17 sessions of telegamma therapy. Prior to each session some patients were the administered cystamine. A correlation was noted between the frequency of the main types of chromosome aberration, pair fragments and dicentric chromosomes, and a total dose of fractionated local irradiation. A pharmacologically active dose of cystamine (0,8g) prevented damaging action of radiation on genetic structures of human blood cells. Cystamine in a dose of 0,8g could be administered daily before each session of irradiation. (auth)

15959 RADIATION INJURIES OF EYES INDUCED BY RADIOTHERAPY OF MAXILLARY CANCER. Hirano, M.; Mihashi, S.; Ichikawa, A.; Okada, M.; Yoshioka, H. (Kurume Univ., Fukuoka). Nippon Jibi Inkoka Gakkai Kaiho; 76: No. 4, 456-463(Apr 1973). (In Japanese).

Various factors of eye disturbances due to radiation therapy were examined in 26 clinical cases with cancer of the upper jaw. Lesions were classified according to the region of the eye. The eye disturbances in seven of these 26 cases (27%) were clearly due to radiation: three cases with irradiation cataract, three cases with radiation retinosis, and one case with both irradiation cataract and retinosis. Irradiation cataract appeared one year after radiation, and its occurrence tended to increase with time. In addition, large doses of radiation, especially more than 5,000 rad, seemed to increase the incidence of this disease. There was a higher incidence in the cases exposed with Linac radiation than in the cases with ^{60}Co radiation. Radiation retinosis as well as irradiation cataract was observed one year after irradiation and all of the cases were irradiated with linac radiation. Radiation retinosis was induced with a comparatively smaller dose than with radiation cataract, which required a much larger dose. In addition, the disturbances in each lesion were examined, showing dysfunction in 12 of the 26 cases (46%). Dysfunction due to radiation was seen in four of the 26 cases (15%). Three cases without dysfunction were diagnosed as radiation retinosis by the fluorescence opthalmoscopic photography method. (JA)

15960 ACUTE SECOND DEGREE BURN OF THE SKIN BY A RADIOACTIVE SOURCE. Kuzelova, M. (Okresni Ustav Narodniho Zdravi, Pardubice, Czech.); Sabatova, M. Prakt. Lek.; 53: No. 11, 438-439(5 Jun 1973). (In Czech).

The case is described of a patient who suffered an acute 2nd degree burn as a result of careless handling of an ^{192}Ir source used in nondestructive testing. The skin lesion healed within three weeks after exposure. The medical examination carried out 1½ years after exposure revealed epilation on the hand dorsum. The risks are pointed out of delayed radiation effects resulting from exposure in handling radioactive sources while not observing safety regulations. (auth)

15961 USLOVIYA TRUDA I PROVETRIVANIE KAR'EROV PO DOBYCHE RADIOAKTIVNYKH RUD. (Conditions of Work and Ventilation of Pits in Mining of Radioactive Ores). Bitkolov, N. Z.; Inkitin, V. S. Moscow; Atomizdat (1973). 184p.

Sanitary-hygienic working conditions of the pits in mining of radioactive, non-ferrous, submetallic, and other ores are examined. Procedures for controlling air exchange in the pits under different meteorological conditions and with different pit geometries are described. Methods for normalizing and maintaining the composition of the air in separate working areas and in the pits as a whole are reported. Apparatus and methods for decreasing dust in the air with basic technological processes and for decreasing the stirring up of dust, and suitable methods for local and general pit ventilation are discussed. Considerable attention is paid to proposed and projected methods for improving the air composition of the pits and the microclimate parameters in work areas. Projection of methods is based on complex calculations of geographical, meteorological, geological, and technological factors. Recent advances in aerology, ventilation, dust trapping, and gas purification in pits are discussed. (tr-auth)

15962 PROBLEMS OF SPACE RADIOBIOLOGY AND RADIATION SAFETY IN SPACE MISSIONS. Tobais, K. A.; Grigor'ev, Yu. G. Kosm. Biol. Med.; 8: No. 1, 12-21(1973). (In Russian).

Main criteria of assaying radiation hazards of different space flights and qualitative characteristics of these criteria are presented. The results of space radiobiology investigations are given. Approaches to the establishment of allowable levels of an exposure of astronauts to irradiation are described. Purposes of advanced researches are determined. (auth)

15963 DIRECT METHOD OF MEASURING TOTAL RADIATION DOSE TO THE BRAIN USING THE FRICKE DOSIMETER. Werner, A.; Modan, B. (Sheba Medical Center, Tel Hashomer, Israel). pp 3-15 of Proceedings of the 6th National Conference of the Israel Health Physics Society. Schlesinger, T. (ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From 6th national conference of the Israel Health Physics Society; Nahal Soreq, Israel (19 Dec 1971).

Doses of radiation to the brain of children receiving x-ray therapy for Tinea Capitis were determined by the use of chemical dosimetry. The average dose absorbed by the brain of a 7 year old child was 99 ± 4 rads. This average dose measured with chemical dosimetry was compatible with the lower doses obtained with the ionization chamber method. An experimental model was devised to determine the effective photon energy of the radiation. On the basis of these results it is suggested that chemical dosimetry could have wider applicability in the measurement of doses absorbed by functionally homogenous organs. (INIS)

15964 NEW APPROACH TO EVALUATING THE EXPOSURE OF PERSONNEL TO IONIZING RADIATION. Klener, V. (Inst. of Hygiene and Epidemiology, Prague). Prakt. Lek.; 25: No. 4, 161-163(Apr 1973). (In Czech).

New concepts are discussed of evaluating the exposure of personnel to ionizing radiation. Discussed are the concepts and units of radiation dose, dose equivalent, and dose commitment. Also the concepts of working limits and derived working limits are dealt with and the reasons are given for their introduction, mainly a better feasibility of monitoring and the concern for specific working conditions. (INIS)

15965 DOSIMETRY STUDIES TO PERSONNEL OPERATING PORTABLE IMAGE AMPLIFIERS. Malsky, S. J. (Hospital for Special Surgery, New York); Freiberger, R.; Gregory, W.; Hayt, D.; Blatt, C.; Simon, D.; Decrescenzo, L. Health Phys.; 26: No. 1, 97-99(Jan 1974).

From 17th annual meeting of the Health Physics Society; Las Vegas, NV (12 Jun 1972).

In hip-pinning procedures performed in the operating room, using conventional radiographic equipment, 15 to 30 films are taken in a 45 to 90 min period while for hip-resection procedures 15 to 50 films are taken in 2 to 4 hr. If a portable image amplifier is used in place of the conventional equipment, a 30 to 50% reduction of exposure to personnel is found while the total operating room time is reduced by about 50%. Recommendations to increase safety standards for both patient and personnel are given. (UK)

15966 RADIATION LOAD MEASUREMENTS IN THE CASE OF COVERING OF THE AREAS LYING OUTSIDE OF THE IRRADIATION FIELD, IN ORTHOVOLT THERAPY. Deszi, Z.; Vargha, G.; Miltenyi, L.; Patko, J.; Felszerfalvi, J. Magy. Radiol.; 25: No. 5, 294-298(Oct 1973). (In Hungarian).

Examinations were performed in order to establish, to what extent the skin's radiation load is influenced by covering the areas lying outside of the irradiation field with lead rubber plate. It resulted from their measurements that in the case of irradiations with greater half-value thickness, the diminution corresponded to 0.5 to 1%. It is pointed out that inaccuracy of the field adjustment is a very important factor in respect of the skin load outside the irradiation field. (auth)

15967 ESTIMATION OF BENEFITS AND RADIATION RISKS FROM STOMACH MASS X-RAY SURVEY IN JAPAN. Kitabatake, T. (Niigata Univ., Japan); Yokoyama, M.; Sakka, M.; Koga, S. Strahlentherapie; 146: No. 3, 352-358(Sep 1973).

Nearly $2,200 \times 10^3$ examinations of the fluorographic mass survey of the stomach were carried out in Japan in 1970. The number of cases of gastric cancer detected by this survey was 2,423 or 0.11%. Of 2,423 patients, 1,042 are expected to survive for more than 5 years, which indicates the absolute benefit of the stomach mass survey. On the other hand, the radiation risk from mass radiography is estimated to be 30 leukemias and 15 lethal abdominal cancers in the forthcoming 25 years, 16 deaths from non-specific shortening of life span (shortening of 70 years to be regarded as one death), and to be 31 genetic deaths in all future generations, totaling 92 deaths. If young persons under 39 years old are excluded from the mass survey objects, 63 curable gastric cancers would be lost, with reduction of 34 deaths due to radiation risks. (GE)

15968 REDUCTION OF PATIENT RADIATION DOSE IN DIAGNOSTIC RADIOLOGY. Naveh, M.; Donagi, A. (Ministry of Health, Jerusalem). pp 73-84 of Proceedings of the 6th National Conference of the Israel Health Physics Society. Schlesinger, T. (ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From 6th national conference of the Israel Health Physics Society; Nahal Soreq, Israel (19 Dec 1971).

Medical exposure constitutes today, and in the foreseeable future, the major irradiation source of the population at large. The genetically significant dose contributed by medical sources to the present generation is estimated as 0.2 to 2.0 Rem. Medical sources include both diagnostic and therapeutic sources. The genetically significant dose, resulting from radiotherapy, is estimated to be a tenth to a third of the dose resulting from diagnostic exposure. It is most important therefore, that all feasible means of reducing the dose while carrying out diagnostic procedures should be taken. In the present investigation the possibilities of reducing skin and gonadal doses, by changing various physical parameters, were studied. It was found that increase of the high voltage from 70 to 145 kVp with simultaneous increase of the filtration from 2 mm Al to 4 mm Al, 0.2 mm Cu resulted in reduction of the skin dose by factors of about 2.8 and 9.6 for chest and abdomen radiographs respectively. For the lumbo-sacral exposure, the dose reduction for a voltage change from 85 to 145 kVp and the same addition of filtration was by a factor of about 5.3. (INIS)

15969 MEAN ABSORBED DOSES IN TRANSPORT WORKERS IN ITALY IN 1969 AND 1970. Roberti, M.; Roselli, A.; Susanna, A. (CNEN, Rome). G. Fis. Sanit. Prot. Radiaz.; 16: No. 1, 31-46(1972). (In Italian).

Comparison between mean absorbed doses in transport workers in Italy in the periods 1967 to 1968 and 1969 to 1970 showed a gradual decrease in values due to an increase in the number of journeys and carriers and a decrease in the transport index per package. To obtain a more complete picture, a statistical inquiry was undertaken to determine the distributional frequency of isotopes commonly employed for therapeutic, diagnostic, industrial, and research purposes. For this purpose, package activity, transport index, type of packing, and category data were examined. The main aim of the study was the identification of problems related to the protection of persons engaged in the transport of radioactive materials. (auth)

15970 MANREM IN WORKING ENVIRONMENTS IN NUCLEAR POWER PLANTS. Delpia, M. Pollut. Atmos.; 15: No. 57, 17-57 (Jan 1973). (In French).

From 17th international congress on occupational health; Buenos Aires, Argentina (17 Sep 1972).

The manrem is defined from a mathematical expression for the damage caused by irradiation. The irradiation of groups of workers in nuclear power plants is then discussed, the damage corresponding to this irradiation being theoretically evaluated. The values obtained are also discussed. (FR)

15971 NEW WAYS IN CANCER RADIOTHERAPY. Czerniak, P. (Sheba Medical Center, Tel Hashomer, Israel). Harefuah; 83: No. 2, 83-86(Jul 1972). (In Hebrew).

A new technique in radiotherapy of cancerous tissues, based on high LET therapy, was developed. This therapy uses negative pions (Pion therapy) as the ionizing radiation. This radiation has a higher LET factor when it penetrates the cancerous tissue (especially the

hypoxic tissue), than when it penetrates the healthy tissues with normal oxidation. In the body, where the nucleons bursts occur, because of trapping or stoppage of the pions, there is a high concentration of ionizations, a larger quantity of energy is absorbed, and the destruction is greater. A table that compares some therapeutic parameters of gamma rays from ^{60}Co and negative pions is also given. (INIS)

15972 CLINICAL USE OF DEOXYPYRIMIDINURIA AS BIOCHEMICAL DOSIMETER IN THERAPY OF MALIGNANT LYMPHOGRANULOMAS. Dienstbier, Z.; Bechyne, M.; Buric, L.; Kovarikova, H.; Blazek, L. (Karlova Univ., Prague). Cas. Lek. Cesk.; 112: No. 15, 475-477(13 Apr 1973). (In Czech).

Six patients suffering from Hodgkins disease were treated both by chemotherapy and radiotherapy. A considerable increase in the excretion of pyrimidine deoxyribonucleosides could be observed following both irradiation and chemotherapy using cytostatics. The results indicate that the phenomenon can not only be used in the ascertainment of the efficiency of individual cytostatics but also in the study of malignant tumours. (INIS)

15973 NUCLEAR DATA REQUIREMENTS IN RADIOLOGICAL PROTECTION AND RADIOTHERAPY. Dennis, J. A. (National Radiological Protection Board, Harwell, Eng.). pp 313-327 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

Estimates of somatic and genetic risks to man arising from exposure to low levels of ionizing radiation are derived by linear extrapolation from the effects observed when humans and animals were exposed to large acute doses of radiation for therapeutic or other reasons; this undoubtedly results in an overestimate of the risks, but no adequate theoretical basis exists for any other form of extrapolation. The dependence of the risk on the quality and type of the radiation is based by convention on the linear energy transfer (i.e., specific energy loss) of the ionizing particles in water. This convention is undoubtedly incorrect. While it must be considered that the present levels of allowable exposure to radiation give adequate protection to the individual and society, the existing uncertainties generate some unease. Although the main obstacle to the resolution of these uncertainties in the absence of a detailed understanding of the biological processes involved, an additional obstacle is the lack of adequate physical data and theories to fully describe the interaction of radiation with matter. This inadequacy affects the accuracy of radiation dosimetry and also makes it difficult to develop theoretical explanations to account for the dependence of biological effects on radiation quality. Similar difficulties exist in the field of radiation therapy, where there is a growing awareness of the advantages of using fast neutrons and accelerated heavy ions for the treatment of tumors. The absence of an adequate theoretical explanation for the dependence of effect of radiation quality makes it difficult to fully evaluate the advantages of using alternative types of radiation other than experimentally. Some of the current attempts at developing theoretical explanations of the dependence of biological effects on radiation dose and quality are described briefly in order to delineate those areas where additional physical data are required. (auth)

15974 PATIENT EXPOSURES IN DIAGNOSTIC RADIOLOGY. Protection Problems of Current Concern. Brit. J. Radiol.; 46: No. 552, 1086-1088(Dec 1973).

The text of a general statement issued by the ICRP (July 1973) is presented concerning the way in which medical uses of ionizing radiation could be optimized. Recommendations are dealt with under the following headings: the need for protection of the patient; balance between benefit and risk; dissemination of ICRP recommendations; observations on the current situation, including frequency, type and purpose of examinations, radiological techniques, and dose per examination; doses of interest; and means of dose reduction. (UK)

15975 ZASHCHITA NASELENIYA OT RADIOAKTIVNYKH OSADKOV. (Protection of the Population From Radioactive Fallout). Sudakov, A. K. Moscow; Atomizdat (1973). 120p.

The causes for the appearance and the character of radioactive contamination and its effect on man are discussed. The characteristics of the dosimetric instruments with which civil defense installations are equipped are given. The individual and collective means for protection and measures for the protection of the population from radioactive materials are examined. Recommendations are given on the adaptation of existing rooms near counterradiation shelters and on the treatment of people during danger of radioactive contamination and in contaminated districts. Regimes for the residence of the population in contaminated districts and measures connected with the elimination of radioactive contamination are also examined. (tr-auth)

15976 APPLICATION OF CHROMOSOME ABERRATION FREQUENCY IN HUMAN LYMPHOCYTES TO BIOLOGICAL DOSIMETRY. Inoue, Y.; Fujita, M. (Japan Atomic Energy Research Inst., Tokai, Japan). Hoken Butsuri; 8: No. 2, 93-99(Jun 1973). (In Japanese).

Biological dosimetry for human subjects is considered. During the past decade techniques were developed for the analysis of radiation-induced chromosome aberrations in human lymphocytes. As a result, a vast amount of studies on chromosome aberrations induced by radiation in human lymphocytes have been carried out. These studies have revealed the relationships between aberration frequencies and absorbed doses. At present this method appears to be the most readily quantifiable one of biological dosimetry available. The problems associated with the use of this method in estimating radiation dose are discussed. These problems include time of sampling after irradiation, culture time, dose rate, type of radiation, and temperature at the time of irradiation. (auth)

15977 PROGRESS IN RADIATION PROTECTION THROUGH THE NEW X-RAY ORDINANCE. Jeiter, W. (Bundesministerium fuer Arbiet und Sozialordnung, Bonn); Krebs, A. Arbeitsschutz (Cologne); No. 4, 153-157(1973). (In German).

The importance of the new X-Ray Ordinance for radiation protection is emphasized and discussed under the following aspects: jurisdiction and aims of the new ordinance; basic principles of the ordinance; conditions for the operation (licensing, information); operating instructions (responsibility, control and surveillance region, personal radiation doses, required measurements); medical surveillance of personnel; and operation of existing devices. (GE)

15978 RATIONALIZING THE CALCULATION OF DOSE DISTRIBUTION IN TELECURIETHERAPY. Matula, P.; Futas, F.; Kundstadt, E.; Kivana, M. (Radiologicka Klinika Lekarskej Fakulty UPJS, Kosice, Czech.). Cesk. Radiol.; 27: No. 3, 207-214(May 1973). (In Slovak).

A method is described of simplifying computer programs in the preparation of radiotherapy plans, in the calculation of the exposure time, the surface dose, and other parameters in telecurietherapy. The method is based on the reduction of input data from 60 to 80 down to 2 by the approximation of the patient's silhouette to an ellipse. A more detailed description is presented of the calculation of the exposure time, the surface and the total doses, the integral dose, and the efficient integral factor. The calculations were made using the percent depth dose at a constant source-skin distance. (INIS)

15979 COUNTRY-WIDE SUPERVISION OF X-RAY MACHINES. Donagi, A.; Chai, J.; Naveh, M. (Ministry of Health, Jerusalem). pp 85-99 of Proceedings of the 6th National Conference of the Israel Health Physics Society. Schlesinger, T. (ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From sixth national conference of the Israel Health Physics Society; Nahal Soreq, Israel (19 Dec 1971).

Country-wide supervision of x-ray machines began in the middle of 1965 as a public health service, the purpose of which was to prevent radiation absorption by the population. X-ray machines were the main source of this radiation. Examination of x-ray machines is carried out in accordance with standards set forth in Handbook 76 put out by the NCRP and in NCRP Publications No. 33, 34, 35. Purpose of Supervision: A license to operate is issued to machines according to type. The license is operative for one year and costs IL 50.- per machine. X-ray machines are checked in order to determine whether radiation leakage occurs from the equipment and whether dispersive and secondary radiation endangers other places such as nearby rooms, corridors where patients wait, etc. Reduction of radiation doses to patients and operators is accomplished by means of protection devices. Supervision and followup of removal of defects in x-ray machines are carried out in order to put them into efficient operating condition. Guidance of x-ray machine owners is provided in all matters relating to radiation protection. In accordance with the law, all blueprints for intended x-ray institutes are transmitted to us for approval. In accordance with the law, all applications for import of x-ray machines are transmitted to us for approval. Authorization of places of work in x-ray institutions is made. Recommendations are made for use of film badge service for personal dosimetry. (INIS)

15980 TECHNICAL FACTORS IN DENTAL RADIOGRAPHY IN HIROSHIMA AND NAGASAKI. Kihara, T.; Antoku, S.; Fujita, S.; Beach, D. R.; Russell, W. J.; Mizuno, M.; Nishio, S. J. Amer. Dent. Assn.; 88: No. 2, 367-377(Feb 1974).

Diagnostic radiography is an important source of ionizing radiation exposure for populations throughout the world. More particularly, it is acting as a contaminant in the ongoing assessments of

the effects of ionizing radiation from the Hiroshima and Nagasaki atomic bombs. Therefore, this extensive investigation was conducted to determine the magnitude of dental radiographic exposure. Most other large studies have dealt with the exposure of populations; this one is unique in that it focuses on the exposure individual patients receive. Interviews of 2,968 persons and records supplied by personnel of 207 hospitals and dental clinics established the frequency of and technical factors used in dental radiography. One of the findings of this investigation was that only half of the radiographic units had the filtration required by governmental regulations. The majority of dentists used intermediate rather than high-speed film. Darkrooms were a rarity, and instead, special film packets were most frequently used; processing solutions are injected into the packets, permitting instant processing in lighted areas. (auth)

15981 OCCUPATIONAL RADIATION EXPOSURE IN OUR HOSPITAL. Watanabe, S.; Niizuma, S.; Sawada, Y. (Niigata Prefectural Cancer Center, Japan). Kenrithsu Gan Senta Niigata Byoin Ishi; 10: No. 3, 200-206(Sep 1971). (In Japanese).

The transition in exposure doses to physicians, technicians, and nurses is described during an 8-year period beginning May, 1963 through March, 1970. Radiation sources include x rays, gamma rays, and beta rays. The observations were made of the annual transition in exposure doses by total exposure doses, kinds of radiation sources, occupational groups, and the field of specialization. The results are represented in separate tables. In general the exposure dose has been decreasing, indicating that the objective of protective management for the individual worker is achieved. However, further effort should be made to provide some physicians with education and training necessary for preventing any disturbance due to the exposure to radiation. (Japan)

15982 FAILURE OF HAND GROWTH AFTER X-RAY THERAPY. Goh, Y. S.; Khor, T. H. (Outram Road General Hospital, Singapore). Singapore Med. J.; 14: No. 1, 19-22(Mar 1973).

Late radiation damage to skin and bone, from superficial x-ray treatment for warts 18 years previously, is described in a 23 year old man. These effects are briefly described in relation to the dose received by the different tissues. Possible further complications in this patient by way of radiation-induced cancer are outlined. (auth)

15983 SMALL BOWEL INJURY FOLLOWING RADIATION THERAPY FOR CERVICAL CANCER. van Nagell, J. R. Jr.; Maruyama, Y.; Parker, J. C. Jr.; Dalton, W. L. (Univ. of Kentucky, Lexington). Amer. J. Obstet. Gynecol.; 118: No. 2, 163-167(15 Jan 1974).

From July 1962 to January 1972, 271 cases of invasive cervical carcinoma were evaluated, staged, and treated by radiation therapy at the University of Kentucky Medical Center. The total tumor and paracervical dose varied from 7,000 to 9,000 rads, and 5,000 to 6,000 rads was delivered to the lateral pelvic walls. Within 6 to 60 months following therapy, 8 (2.9 per cent) of these patients developed small bowel obstruction in the absence of tumor. Surgical procedures were performed on 4 patients, and histologic examination of the resected bowel showed changes consistent with previous irradiation. All 271 patients were evaluated with respect to age, gravidity, height, weight, pretreatment hemoglobin, stage of disease, diabetes mellitus, and hypertension. In the population studied, the thin, diabetic, hypertensive patient was found to be particularly susceptible to the development of small bowel injury following radiation therapy for cervical carcinoma. (auth)

15984 ENGINEERING IN MEDICINE AND BIOLOGY. Volume 14. Proceedings of the Annual Conference, Bal Harbour, Florida, October 1-5, 1972. Arlington, VA; Alliance for Engineering and Medicine and Biology (1972). 421p. (CONF-7210110-). $15.00.

Eight papers were presented on medical radiology. An additional 318 papers were presented on various aspects of engineering applications in medicine and biology. (HLW)

Vertebrates

Refer also to abstracts 15834, 15859, 15861, 17985, and 17986.

15985 (CEA-R-4483) CONTRIBUTION TO THE STUDY OF THE RADIOPROTECTIVE EFFECT OF SEROTONIN ON BRAIN SPONTANEOUS AND EVOKED ELECTRICAL ACTIVITIES IN THE ADULT RABBIT FOLLOWING WHOLE-BODY LETHAL γ-IRRADIATION. Fatome, M.; Court, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Nov 1973. 103p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis. Submitted to Paris Univ., (France).

A 1 to 12 mg/kg serotonin-creatine-sulfate intravenous injection seems to act only slightly on the chronic implanted rabbit CNS except for an increase in latencies and delays of the fast components of evoked potentials and a generalized decrease in the total energy of the signal occurring 20 to 60 min after the injection. The CNS is given a real protection by a 10 mg/kg serotonin injection 20 min before a 650 R whole-body exposure, the spontaneous or induced electrical activity being slightly disturbed. In the hours following irradiation the total energy increase is less important than in the unprotected animal, and there is no clear variation towards the low frequencies. Serotonin could act on the brain structures and the total energy of the signal through its depressing effect. Its radioprotective effect could act, at least partly, through the CNS. (auth)

15986 (UCSF-10-P-2-219) TIME-DOSE RELATIONSHIPS IN THE MOUSE ESOPHAGUS. Phillips, T. L.; Ross, G. (California Univ., San Francisco (USA)). 1973. 28p. (CONF-731123-2). Dep. NTIS $3.50.

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, Illinois, USA (25 Nov 1973).

Histologic studies indicate that early deaths after thoracic irradiation are secondary to esophageal denudation, perforation, infection, and the associated inanition. Deaths occur between one and three weeks after x irradiation with a minimum point appearing in the LD_{50} at twenty-eight days. For single doses the $LD_{50/28}$ is 2682 rads; with fractionation this increases to 3527 rads in 2 fractions and 5745 in 10 fractions. To determine the influence of time on recovery, 2 doses spaced one, seven, fourteen, and twenty-eight days apart were used. From the resulting data the slope of the relationship between number of fractions and dose and number of days and dose was determined and a formula for calculating equivalent single doses was developed: $TD = ED \cdot N^{0.28} \cdot T^{0.06}$. (auth)

15987 AGE FACTOR IN THE DEVELOPMENT OF RADIATION CATARACT. Szechter, A. New York; New York Univ. (1973). 149p. University Microfilms Order No. 73-28,568.

Thesis (Ph. D.).

The effect of age on the development of radiation cataract in mammalian lenses was investigated using the Columbia-Sherman rat as an experimental model. Criteria for evaluation and comparison of radiosensitivity as determined by cataractogenesis were defined more precisely than previously reported. A rather detailed pattern of age dependence was obtained at several different dose levels. The prevalent statement that young lenses are more radiosensitive than adult ones was shown to be a gross oversimplification. The sparing effect of fractionation was compared and found similar in young and adult lenses. Preliminary results on cell kinetics after irradiation in young and adult lenses are reported. (Diss. Abstr.)

15988 LYMPHOCYTOPOIESIS: THE LYMPHOID TISSUE RESPONSE TO PERIPHERAL DEPLETION OF LYMPHOCYTES BY EXTRACORPOREAL IRRADIATION OF BLOOD IN GOATS. Gulliani, G. L. Jamaica, NY; St. John's Univ. (1973). 156p. University Microfilms Order No. 73-29,955.

Thesis (Ph. D.).

In an attempt to gain some insight into the fundamental problem of regulation of lymphocytopoiesis at individual lymphocytopoietic sites and/or in the lymphoid mass at large, an experiment was designed to study the response of various lymphoid tissues (thymus, lymph node, spleen, Peyer's patch, bone marrow, blood and thoracic duct lymph) to peripheral depletion of circulating lymphocytes by extracorporeal irradiation of blood (ECIB). Sixteen goats were given ECIB while another sixteen received sham-ECIB and served as controls. A maximum of 50 blood volumes were irradiated (or sham-irradiated) over a period of 7 days at the rate of 7 blood volumes per day with 8 blood volumes given on the last day. A gamma emitting 3600-curie ^{137}Cs irradiator was used. The average transit dose i.e., the dose received by a particle (a cell in this case) in each transit through the radiation field was 300 rads. Lymphocyte concentration in the blood, thoracic duct lymph, spleen, lymph node, thymus and Peyer's patches decreased as a result of ECIB. Blood and thoracic duct lymphocyte concentration had not returned to control levels by the end of 2 months following cessation of ECIB. The lymphocyte content of the depleted lymphoid organs with the exception of the spleen, returned to control levels within the experimental period (i.e., 2 months). Lymphocytopenia induced by ECIB resulted in an increased flash labeling index in the bone marrow, Peyer's patches, blood and thoracic duct lymph. Bone marrow, unlike other tissues, not only failed to show any decrease in the lymphocyte concentration, but also showed the maximum increase in the flash labeling index. The most significant outcome of the present study is the

finding that peripheral lymphocytopenia induced by ECIB stimulated the lymphocytopoietic activity of the bone marrow, implying that a feedback mechanism probably exists for the regulation of lymphocytopoiesis. (Diss. Abstr.)

15989 EFFECT OF X RADIATION (800, 1,000, AND 1,400 R) ON THE OVARIES OF LAYING HENS. Albrecht, F. Munich; Univ. Munich (1971). 66p. (In German).

Thesis.

The ovaries of white leghorn hens were irradiated with 800, 1100, and 1400 R as a single dose for each group. The result was only a temporary castration. The hens irradiated with 1100 and 1400 R after onset of the production showed inflammation of the oviduct and the peritoneum, which might be caused by a functional damage of the infundibulum. To estimate whether the function of the ovary was destroyed by x rays, blood proteins and blood calcium level were determined. They showed a significant decrease in the hens irradiated with 1100 and 1400 R. But they can't be declared as parameters for a successful castration with x rays, because after 800 R the production ceases without significant changes in blood proteins and plasma calcium levels. The histological examination showed radiation damage in the follicles and the germinal epithelium and a proliferation of connective tissue. (GE)

15990 REGENERATION OF GASTRIC GLANDULAR EPITHELIUM IN ADULT MICE AFTER EXPOSURE TO 1-MeV FAST NEUTRONS. Davids, J. A. G. (Stichting Reactor Centrum Nederland, Petten). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Nuremburg, Germany (22 Oct 1973).

A severe destruction of the glandular epithelium of the stomach develops after whole-body irradiation of mice with fast neutrons in the upper lethal and supralethal dose-range. In the first week after exposure the cells decrease in number especially in the gastric pits. In the second week extensive necrosis of cells occurs in the fundic glands. Cellular proliferation starts in the isthmus region of the glands. The regeneration of the epithelium of the gastric pits proceeds quickly and at the end of the second week a new layer of surface epithelial cells has been formed. The regeneration of the epithelium of the fundic glands proceeds more slowly. First, a continuous layer of mucous neck cells is formed during the third week. In the fourth week a layer of parietal cells grows between the basal membrane and the mucous neck cells and finally zymogenic cells differentiate in the bottom of the glands within six weeks after irradiation. The results show that even after a severe generalized destruction, the glandular epithelium of the stomach in the adult organism has preserved the potential of full regeneration. (GE)

15991 TRANSFER OF PRIMARY LYMPHOID CELLS TO IRRADIATED ANIMALS. Urbain-Vansanten, G.; Van Acker, A.; Urbain, J. (Univ., Brussels). Arch. Int. Physiol. Biochim.; 81: 206-208(Feb 1973). (In French).

Lymphoid cells were obtained from rabbits hyperimmunized against TMV and characterized genetically by the allotype A1 on their immunoglobulin. Intravenous injections of the cells were given to irradiated rabbits injected with TMV and with the allotype A3 on their immunoglobulin. Blood was removed from the recipient rabbits at intervals and the antibodies were purified. Results showed that during the first week after injection of lymphoid cells immunoglobulins with the donor allotype A1 appeared in the serum of recipient rabbits. These immunoglobulins did not contain TMV antibodies. TMV antibodies with the allotype A3 were synthesized by the recipients. (HLW)

15992 INHIBITION OF RAT TESTICULAR MONOAMINE OXIDASE ACTIVITY AFTER 250 R OF WHOLE-BODY X IRRADIATION. Urry, R. L.; Ellis, L. C. (Utah State Univ., Logan). AT(11-1)-1602. Experientia; 29: No. 10, 1223-1225(15 Oct 1973).

Rats were given 250 R whole-body x radiation; controls were sham irradiated. The rats were sacrificed at 3-day intervals up to 153 days after treatment. The testes were removed and tissue preparations were assayed for monoamine oxidase (MAO) activity. The activity of MAO from irradiated rats was higher than that of controls from 7 to 16 days after treatment and lower from day 19 to 31. MAO activity was increased 80 days after irradiation together with a significant increase in testicular weight and regeneration of the seminiferous tubules. MAO activity at 153 days after treatment was not significantly different between the two groups of animals. (HLW)

15993 LETHAL EFFECTS OF 14-MeV FAST NEUTRONS ON FROG EGGS AND CULTURED MAMMALIAN CELLS. Takeshita, K.; Sawada, S. (Hiroshima Univ.). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Nuremburg, Germany (22 Oct 1973).

To study the effect of fast neutrons on the cell cycle of developing frog embryos, Rana nigromaculata and Rana japonica eggs were artificially inseminated with their own sperm and irradiated with 180 kV x rays or 14-MeV neutrons at various times after insemination. Normal survivors were counted at the hatching stage as a criterion. When R. nigromaculata eggs were irradiated with 60 rads of x rays, the cell cycle dependency of their radiosensitivity was established. A similar pattern was also found for R. japonica eggs after 100 rads x-irradiation. When R. nigromaculata eggs were irradiated with 25 rads neutrons, the survival rate at the second resistant stage was reduced and the subsequent cyclic response became irregular. The dose-response to x rays and neutrons at the first sensitive stage and the second resistant stage of R. japonica eggs was examined. It was found that the RBE, ratio of D_0, of neutrons to x rays was higher (3.0) in the resistant stage than the sensitive stage (1.2). It appears that 14-MeV neutrons are incapable of flattening the stage dependency of radiosensitivity in developing frog eggs. Using L5178Y mouse leukemic cells, the lethal effects of neutrons were compared with those of x rays for colony forming ability in both the exponentially and stationary growing cells, at normal and very low temperatures. From dose-survival curves it was concluded that, in both exponential and stationary growth phases, the D_0 dose of cells irradiated in the frozen state was higher than that incurred at 37°C, but there were no significant differences among the D_0 doses to the cells irradiated at −15, −78, and −196°C. However, freezing the cells increased the RBE values of neutrons as compared to x rays, in both growth phases. The sensitivity of the stationary growing cells to x rays at 37°C, on the other hand, was found to be lower than that of the exponentially growing cells and this difference became more apparent in cells irradiated in the frozen state. However, there was little difference between the two growth phases as to their sensitivity to neutrons, either at 37°C or in the frozen state. (GE)

15994 EXPERIMENTAL STUDIES OF RADIATION INJURY OF KIDNEY BY USING RADIOISOTOPE RENOGRAPHY. Hoshino, T. (Iwate Medical Coll., Morioka, Japan). Iwate Igaku Zasshi; 25: No. 2, 240-254(Apr 1973). (In Japanese).

Healthy rabbits with the body weight averaging 3.0 kg were used for the experiment. A single irradiation of ^{60}Co gamma rays was given to the left kidney with 4×5 cm^2 of irradiation area in doses of 1000, 2000, and 5000 R. After irradiation, radioisotope renography and histologic examinations were carried out at certain intervals. The 1000 R irradiated kidney showed a decrease in the renogram index starting three days after irradiation followed by a gradual and progressive decrease. The non-irradiated kidney also showed a very mild decrease in the renogram index starting five days later with a gradual and progressive decrease. The rate of decrease, however, was constantly less than that of the irradiated kidney and showed a tendency to elevation after 10 weeks. In the 2000 R irradiated group the renogram index of the irradiated kidney began to decrease starting three days after irradiation with a gradual and progressive decrease. Fourteen weeks later, the irradiated kidney showed a pattern similar to the nephrectomized pattern. In the 5000 R irradiated group one day after irradiation, the renogram index of the irradiated kidney showed a remarkable decrease. After irradiation, a transient increase in secretory ability of the irradiated kidney paralleled the increase of irradiation dose which was interpreted as the result of increased renal blood flow caused by irradiation. The hypofunction of the non-irradiated contralateral kidney may be related to the cytotoxic action of the antibody against the antigen substance formed by the irradiation-induced degenerative tissue. (auth)

15995 EFFECTS OF X-RAY IRRADIATION IN EARLY POSTNATAL RATS ON SUBSEQUENT DEVELOPMENT OF OVARIES. Matsumoto, A. (Tokyo Univ.). Annot. Zool. Jap.; 45: No. 2, 80-87(Jun 1972).

Adult female rats having received irradiation of the trunk only or whole-body irradiation with 190R of x rays at 10 days of age exhibited morphological and functional changes in the ovaries. At 90 days of age, the ovaries of those submitted to whole-body irradiation were markedly reduced in size, containing small anovular follicles and many nodular masses of small cells but neither healthy-appearing follicles nor corpora lutea. In trunk-irradiated animals, the ovaries were likewise decreased in size but contained some follicles and a good many regressive corpora lutea besides nodular masses of small cells. Prolonged or persistent cornification of the vaginal epithelium took place in a majority of the whole-body-irradiated rats, while about half the number of those given trunk-irradiation had almost regular estrous cycles. If x rays were applied to the head only, the ovaries were not much deviated in structure from those of the non-irradiated controls. Thus, the irradiation of the head exerted perceptible effects on the ovary only when the trunk was also exposed to x rays. (auth)

15996 ACTION OF X IRRADIATION ON DNA SYNTHESIS IN THE CELLS OF THE UTERINE EPITHELIUM DEPENDING ON THE LEVEL OF HORMONAL STIMULATION. Mkrtchyan, S. A. (Inst. of Medical Genetics, Moscow). Byull. Eksp. Biol. Med.; 74: No. 11, 96-99(Nov 1973). (In Russian).

The effect of x-irradiation on DNA synthesis in the cells of the uterine epithelium of ovariectomized mice was studied in relation to the level of hormonal stimulation with the aid of autoradiography and the use of thymidine-^{3}H. With local irradiation in a dose of 400 R a fall of the labeled nuclei index differed depending on the dose of synestrol (against whose background the irradiation was carried out) and on the phase of mitotic cycle at which the majority of the cells of the uterine epithelium were found. (auth)

15997 MICROCIRCULATION OF THE TUMOR AND RADIOSENSITIVITY. Significance of Clinical Application. Tanaka, Y. (Tenri Hospital, Nara, Japan). Gan No Rinsho; 19: No. 9, 922-928(Sep 1973). (In Japanese).

About 0.02 to 0.05 cc of ^{133}Xe was injected into the tumor and the clearance curve was drawn to examine the regional blood flow in the tumor. The relationship between the regional microcirculation in the tumor and the radiosensitivity was also studied. In the Ehrlich subcutaneous tumor prepared by transplanting the ascites tumor cell to the back of a mouse, the amount of blood flow decreased rapidly when the tumor size became more than 0.5 to 1.0 cm^3. In the human tumor developed in the bilateral cervical region, the axilla, and the subcutaneous site, the amount of blood flow tended to decrease with the growth of the tumor. The microcirculation in malignant lymphoma was higher than that in squamous cell carcinoma. The relationship between the rate of healing of the tumor and the amount of blood flow was next examined. In the Ehrlich subcutaneous tumor, the rate of healing was high when the amount of blood flow was great, while it was low when the amount was little. In the cancer of the uterine cervix, the amount of blood flow in the cells with low radiosensitivity was lower than that in the cells with high radiosensitivity, and the recurrence cases after radiotherapy showed also low blood flow. Changes of the amount of the blood flow during and after radiation with the Betatron and ^{60}Co were examined. The blood flow of the Ehrlich subcutaneous tumor decreased rapidly by radiation of a single dose of 2000 rads, but by fractional radiation of 3000 rads daily in 7 days, the decrease was more moderate than that by radiation of massive dose at one time. Malignant lymphoma, adenocarcinoma, and squamous cell carcinoma in the human body were irradiated with 200 rads a day for 5 days in a week. In seminoma and malignant lymphoma with high radiosensitivity, the amount of the blood flow showed the highest level within two weeks and then decreased. In a radioresistant tumor, the amount of blood flow did not show peak level and decreased gradually during radiation. From the above results, reoxygenation of the tumor during radiation was discussed. (JA)

15998 COMPARATIVE STUDY ON THE RESPONSE OF THE RETICULAR TISSUE TO THE ADMINISTRATION OF RADIOSTRONTIUM (^{90}Sr) AND TOTAL-BODY X-IRRADIATION IN MICE. An Investigation on the Comparative Histogenesis of Radiation-Induced Leukemogenesis. Yamasaki, T. (Hiroshima Univ.). Med. J. Hiroshima Univ.; 21: No. 1-2, 61-92(Feb 1973). (In Japanese).

Female ICR/JCL mice were injected intraperitoneally with 1.0 microcurie/g of ^{90}Sr. The hematological, patho-histological, cytogenetic, and radiological findings of these mice were compared with those in mice exposed to fractionated total-body x-irradiation of 680R (4 times at 170R each, at a 5 day interval). A drastic leukopenia caused by total-body x-irradiation was followed by a smooth recovery whereas leukopenia developed following ^{90}Sr injection was relatively mild, appeared more slowly, and lasted for a longer period. Total-body x-irradiation provoked injuries both in granulopoiesis and lymphopoiesis whereas ^{90}Sr gave rather selective damage in the granulopoiesis. The changes in the weight of lymphoid tissues following total-body x-irradiation was uniform, reflecting the homogeneous damage in the tissues whereas the weight change was negligible in ^{90}Sr-injected mice except the weight loss of lymph nodes on and after 60th day of injection. In x-irradiated mice, a vigorous regenerating process in the medullary and extramedullary hematopoiesis took place a few days after the last exposure. The regeneration in the peripheral lymphoid tissues was apparently slower than that in the thymus, indicating the dependence of the lymphoid tissue upon the thymic function. A long lasting medullary hypoplasia and the skeletal hyperplasia were the only characteristic findings in ^{90}Sr-injected mice. In x-irradiated mice, a small focus of atypical cells with many mitotic figures was found in the deep cortex of an atrophic lobe of the thymus as early as 30 days after treatment. In ^{90}Sr-injected mice, appreciable histological changes were confined within the bone marrow up to 60 days after injection. Cytogenetic studies revealed that, in x-irradiated mice, an increase in the aberrant cell population in the thymus on and after 60th day of treatment was preceded by an abrupt increase in the chromosomally aberrant cells in the bone marrow shortly after the treatment. The estimation of the residual radioactivity in various tissues after ^{90}Sr injection indicated that a sustained hypoplasia of the medullary hematopoiesis was induced by the selective and prolonged deposit of the isotope in the skeleton. (auth)

15999 STRAND BREAKS AND 5′ END-GROUPS IN DNA OF IRRADIATED THYMOCYTES. Coquerelle, T.; Bopp, A.; Kessler, B.; Hagen, U. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 24: No. 4, 397-404(Oct 1973).

Rat thymocytes suspended in Hank's solution were irradiated with 10 MeV electrons up to 6 Mrads in air at 0°C. Single- and double-strand breaks in the DNA were determined in the analytical centrifuge. 5′ end-groups were characterized by specific phosphorylation with polynucleotide kinase before and after phosphatase treatment. The single-strand breaks were formed with an efficiency value of 109 ± 6 eV per break and the double-strand breaks with 1940 ± 110 eV. 14% of the 5′ terminals carried a hydroxyl group and 20% a phosphate group. Polynucleotide kinase did not react with the other 66% 5′ end-groups. For comparison, dry calf-thymus DNA was irradiated in vacuo. Under these conditions, 22% of the 5′ terminals carry a phosphate end group, whereas no 5′OH groups could be found. (auth)

16000 CORRELATION OF CELL TRANSIT TIME WITH SURVIVAL TIME IN ACUTE INTESTINAL RADIATION DEATH OF GERM-FREE AND CONVENTIONAL RODENTS. Tsubouchi, S.; Matsuzawa, T. (Aichi Cancer Center, Nagoya, Japan). Int. J. Radiat. Biol.; 24: No. 4, 389-396(Oct 1973).

The relationship between the survival time of animals and the transit time of epithelial cells in the acute intestinal radiation death of germ-free and conventional rodents was studied. The survival times of those animals that died with typical gastrointestinal symptoms after exposure to large doses of x rays were recorded. The transit times of intestinal epithelial cells, obtained by means of ^{3}H-thymidine autoradiography, were measured. A high correlation (coefficient 0.98) was found between the survival times and the transit times. (auth)

16001 RADIATION AND ACTINOMYCIN D MORTALITY STUDIES. Circadian Variations in Lethality Due to Independent Effects of Either Agent. Concannon, J. P.; Dalbow, M. H.; Weil, C.; Hodgson, S. E. (Allegheny General Hospital, Pittsburgh). Int. J. Radiat. Biol.; 24: No. 4, 405-411(Oct 1973).

C57BL/6 mice were exposed to either ionizing radiation or actinomycin at the peak and nadir or jejunal crypt cell mitotic activity. Animals exposed at the peak were more sensitive than animals exposed at the nadir. Conversely, animals treated with actinomycin D were slightly more sensitive at the nadir. These observations suggest that studies of the combined lethal effects of ionizing radiation and actinomycin D may be complicated by the change in sensitivity of normal tissues to either treatment under the influence of a circadian variable. (auth)

16002 MECHANISM OF RADIOPROTECTION BY CYSTEAMINE. I. Relationship Between Cysteamine-Induced Mitotic Inhibition and Radioprotective Effects in the Livers of Young and Senile White Mice. Mitznegg, P.; Saebel, M. (Univ., Erlangen-Nuernberg, Ger.). Int. J. Radiat. Biol.; 24: No. 4, 329-337(Oct 1973).

The incorporation of ^{3}H-thymidine into liver, DNA, the weight of the liver, its DNA-, RNA-, and protein content, and body-weight were investigated in white NMRI mice at the age of five weeks or two years after (1) intraperitoneal application of 150 mg/kg cysteamine, (2) whole-body irradiation with 500 rads ^{60}Co γ rays, (3) combined application of cysteamine and irradiation. The i.p. application of cysteamine resulted in a transient decrease of the ^{3}H-thymidine incorporation into liver DNA of the five-week-old mice. In two-year-old animals, the incorporation rate was temporarily increased; partial hepatectomy, however, resulted in a decrease similar to that in the young animals. Whole-body irradiation caused an initial decrease of the incorporation rate in both animal groups; subsequently it increased and reached the control values after seven days. At this time, however, the DNA-, RNA-, and protein content was significantly lower in the irradiated animals. Cysteamine given 15 min before irradiation accelerated the recovery processes in the young animals; but in two-year-old mice it was ineffective. A good correlation was seen between the transient DNA inhibition initiated by cysteamine in proliferative liver tissue and the cysteamine-induced acceleration of the recovery processes in the liver. (auth)

16003 MECHANISM OF RADIOPROTECTION BY CYSTEAMINE. II. The Significance of Cyclic 3′, 5′-AMP for the Cysteamine-Induced Radioprotective Effects in White Mice. Mitznegg,

P. (Univ., Erlangen-Nuernberg, Ger.). Int. J. Radiat. Biol.; 24: No. 4, 339-344 (Oct 1973).

The i.p. administration of 150 mg/kg cysteamine led to a transient inhibition of ^{3}H-thymidine incorporation into DNA of liver cells in white mice. It is suggested that this functional suspension of DNA synthesis is probably responsible for cysteamine-induced radioprotective effects, i.e., the acceleration of DNA restoration and the prevention of loss in liver-weight and in the total liver content of DNA, RNA, and protein four and eight days after whole-body γ irradiation with 500 rads. Similar effects were shown after the i.p. administration of 200 mg/kg dibutyryl cyclic 3',5'-AMP. Furthermore, cysteamine itself initiated an elevation of endogenous cyclic 3',5'-AMP in the liver cells. So it was assumed that cysteamine-induced radioprotective effects were mediated by cyclic 3',5'-AMP as intracellular second messenger. It is suggested that cysteamine administration leads to the formation of cyclic 3',5'-AMP, which might induce a transient functional suspension of DNA-synthesis. In that stage the DNA should be more resistant to ionizing radiation. (auth)

16004 OUTLINE OF RADIATION AND BIOLOGICAL EFFECTS. Ichikawa, T. (National Inst. of Radiological Sciences, Chiba, Japan); Egami, N. pp 1-29 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (Ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

The effect of radiation and radioactivity on human beings and their environment is described using fishes and piscine resources as the materials of study. Kinds of radiation, radioactivity, radioactive substances, and their biological effects are reported. As biological effects, the following items were examined: 1) Interaction between radiation and materials; initial reaction between radiation and materials, comparison of the different effects of radiation, primary reaction in the body of organisms and formation of free radicals. 2) Effects on the biologically important molecules; effects on nucleic acid, particularly DNA molecules and influences on protein. 3) Effects on cells; enlargement of disturbance in the metabolic process in cells, disturbance in the multiplication of cells, effects of other (nuclear membrane, membrane of mitochondria, Golgi's apparatus etc.) on cells, disturbance in the individual body caused by cellular disturbance. 4) Quantitative relation between dose and biological effects. 5) Measurement of dose. 6) Factors that control the relation between dose and effect; effect of quality and quantity of radiation at different time, fractional irradiation, internal and external irradiation, whole-body and partial exposure, effect of oxygen and temperature, chemical protective agent, intensifying agent, and difference of radiosensitivity between organisms. Finally, radioactivities in water such as natural radionuclides in water, artificial radionuclides in seawater, and artificial radionuclides in freshwater were mentioned. (JA)

16005 EFFECT OF EXTERNAL IRRADIATION ON FISH EGGS AND EMBRYO. Eto, K. (National Inst. of Radiological Sciences, Chiba, Japan). pp 202-233 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (Ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

Experimental studies of radiological effects on blastulation of ichthyoids in Japan and abroad are summarized and discussed. In the field of ichthyology, clarification of differentiation mechanism using irradiation methods was attempted. Hatching rate, which has been used as the index of radiation hazards by some authors, has been shown to be doubtful because the radiation sensitivity differed according to the differentiation stages of the embryo. Several studies on monster occurrence have been reported using rainbow trouts, gold fishes, and loaches, and the radiation hazards in these reports were summarized and discussed by classifying by organs affected, and by comparing the hazards in each stage to normal blastulation states. As the recent researches, there are experimental studies on growth promotion effect of low dosage irradiation, observations on the Hertig effect, gynogenesis, changes of RNA, and ATP amount, studies on the role of the nuclei during each differentiation stage, and chromosome aberration, etc. (JA)

16006 HEPARIN, A RADIOPROTECTIVE SUBSTANCE. Brueckner, V. (Univ., Hamburg). Umsch. Wiss. Tech.; 73: No. 19, 607(1973). (In German).

The survival rate of whole-body x-irradiated mice was increased significantly from 35% to 60% when heparin was injected before the exposure. According to this finding to the different classes of substances that exhibit radioprotective properties a new one can be added, namely that of the anticoagulants. (auth)

16007 EFFECTS OF INTRACAVITARY IRRADIATION BY CALIFORNIUM-252. Sullivan, M. F.; Beamer, J. L.; Mahony, T. D. (Battelle Pacific Northwest Labs., Richland, WA. (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

The availability of encapsulated ^{252}Cf for cancer therapy has introduced the need for data on the response of normal tissues that are at risk during an intracavitary exposure to a ^{252}Cf implant. The anatomical characteristics of the Hanford Miniature Swine make them useful for studies to determine the short- and long-term effects of intracervically implanted ^{226}Ra or ^{252}Cf. Capsules containing 50 mg Ra or 50 μg Cf were inserted in the cervix with a tandem applicator by an after-loading technique. Thermoluminescent dosimeters were attached to organs adjacent to the sources during laparotomy in some animals. The Ra pigs received a fractionated dose calculated as 7,000 to 14,000 rad at a point 2 cm lateral to the source. The Cf swine received between 2,000 and 6,000 rad. Pigs were either killed weekly to determine the early changes or brought to autopsy later because of delayed effects. Others are being killed from 1 to 3 yr after treatment for studies of long-term effects. Acute damage two weeks after 10,500 rad from ^{226}Ra was similar to that caused by 2,800 rad from ^{252}Cf. Damage consisted of a well defined ulcer on the anterior wall of the rectum adjacent to the source location. The ulcer did not heal and persisted into the late period as a chronic radiation ulcer. The urinary bladder, except at the high doses, did not show gross ulceration, but a diffuse erythema occurred in the trigonal or supratrigonal region of the bladder with varying degrees of petechial hemorrhage. These changes provide an acute RBE of greater than six for both the rectum and urinary tract and indications are that the RBE for long-term effects will be larger than for acute radiation injury. (GE)

16008 ENHANCEMENT OF THE RECOVERY OF HEMOPOIETIC SYSTEM WITH CARBON PARTICLES IN IRRADIATED MICE. Mori, K. J. (Kyoto Univ.). Radiat. Res.; 56: No. 3, 494-506(Dec 1973).

Effect of carbon treatment on retention of peripheral erythrocytes and on hemopoietic recovery following irradiation was studied. Life-span of ^{51}Cr-labeled erythrocytes was shortened to about three-fourths that of normal mice by irradiation (500 R). By previously blockading RES with carbon particles, this accelerated destruction of erythrocytes was prevented. Proliferation of lymphoreticular tissues after irradiation was significantly enhanced by administration of 10 mg of carbon particles. Similar enhancement of erythropoietic recovery was also observed in the carbon-treated mice. Studies on the survival of endogenous spleen colony forming cells revealed that several times as many cells were protected by carbon treatment before or after irradiation. As a possible mechanism for the radioprotective effect of carbon particles, the following is proposed: elongation of the survival time of slightly injured RBC due to the functional blockade of RES and the prevention of internal hemorrhage by carbon-induced reinforcement of sinuses and sinusoids, higher survival of hemopoietic stem cells and enhancement of hemopoietic recovery which follows the above-mentioned response. (auth)

16009 PROLIFERATION OF DONOR THYMUS CELLS IN THE BONE MARROW AND SPLEEN OF IRRADIATED SYNGENEIC HOST MICE. Takada, A.; Takada, Y. (Roswell Park Memorial Inst., Springville, NY). Radiat. Res.; 56: No. 3, 474-480(Dec 1973).

When CBA/H mice were irradiated with 600 R, and injected with 5×10^7 CBA/HT$_6$T$_6$ thymus cells, donor thymus cells comprised nearly 100% of the dividing population in the host lymph nodes and spleen, and more than 70% in the bone marrow on day 5, respectively. The percentages of dividing donor thymus cells quickly declined in the bone marrow and spleen, reaching less than 5% by day 20. When CBA/H mice were irradiated with 600 R, and injected with 1×10^7 CBA/H bone marrow cells plus 5×10^7 CBA/HT$_6$T$_6$ thymus cells, or 1×10^7 CBA/HT$_6$T$_6$ marrow cells plus 5×10^7 CBA/H thymus cells, donor marrow cells comprised more than 50% of the dividing cell population in the bone marrow and spleen on day 5, nearly 100% by day 20. The division of donor thymus cells in the bone marrow was totally suppressed after the injection of marrow and thymus cells. The numbers of dividing cells of donor thymus origin were far smaller in the bone marrow and spleen of mice injected with marrow and thymus cells than in those of mice injected with thymus cells. The time courses of the percentages of dividing donor thymus cells in the thymus were hardly influenced by the simultaneous injection of marrow cells. In conclusion, the thymus has cells capable of repopulating the bone marrow and spleen of irradiated host mice, but the proliferation of donor thymus cells in the bone marrow and spleen is suppressed if marrow cells are injected together with thymus cells. (auth)

16010 LATE EFFECTS OF NEUTRON OR GAMMA IRRADIATION IN MICE. Ainsworth, E. J.; Fry, R. J. M.; Grahn, D.; Williamson, F. S.; Brennan, P. C.; Stearner, S. P.; Carrano, A. V.; Rust, J. H. (Argonne National Lab., IL). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

Data are provided for the development of models of radiation morbidity and mortality so that late effects of low doses of neutron or gamma radiation may be understood and predicted in terms of: the actuarial statistics of disease and death, cell injury and recovery, and tissue and organ injury, repair, and regulation. The late effects experiment in progress is designed to evaluate the additivity of small doses of neutron or gamma radiation, delivered at different intervals and dose rates, over a period of 6 months. Total fractionated doses are 80 or 240 neutron rad and 855 or 1,140 rad of gamma radiation; a single dose series, conducted at 3 ages with mice of both sexes, will assist with estimation of protraction factors as well as age sensitivity to radioinduced lifeshortening. The principal endpoints are death and tumor rates, but various cellular and physiological studies support the late effects experiment. Morphological and functional alterations of the microvasculature, susceptibility to upper respiratory infection, and alterations in the stem cell content of the femur have also been evaluated after single or fractionated doses of neutron or gamma radiation. Chromosomal aberrations in human leukocytes were compared after a single dose of neutron or x radiation. Preliminary mortality results indicate that fractionation of the neutron dose of 240 rad produces greater lifeshortening and higher tumor rates than does the same single dose. Fractionation of the gamma dose of 855 rad results in a sparing effect on lifeshortening and tumor rates, and the protraction factor appears to be about 3. Instantaneous dose rate/fraction, dose/fraction, or number of fractions does not appear to influence the amount of lifeshortening produced by neutron irradiation; effects of these variables on lifeshortening produced by gamma irradiation are not yet clear. The current estimate of RBE for lifeshortening under conditions of one 45-minute exposure per week for 24 weeks is approximately 11. (GE)

16011 RBE VALUES OF 400-MEV AND 14-MEV NEUTRONS USING DIFFERENT BIOLOGICAL EFFECTS. Bianchi, M. (European Organization for Nuclear Research, Geneva); Baarli, J.; Sullivan, A. H.; Di Paola, M.; Quintiliani, M. (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

Experimental determinations of RBE values for a beam of 400 MeV neutrons using a few highly radiosensitive biological test systems were carried out. These include: testes weight loss, survival of spermatogonia type B, and lens opacification in mice, and 10 days' growth of Vicia faba roots. Some of these test systems were also used for similar studies with 14 Mev neutrons. In all investigations, ^{60}Co γ rays or 220 to 250 kV x rays were used as reference radiations. The results obtained are presented and discussed in the light of possible effects from the nuclear processes involved when using the beam of 400 MeV neutrons. All studies were made with dose rates of 5 to 7 rad/h and comparable dose rates for the reference radiation. Possible implications of the results for problems in radiation protection are considered. (GE)

16012 NEUTRON-INDUCED MAMMARY NEOPLASMS. Vogel, H. H., Jr. (Univ. of Tennessee, Memphis). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

Three month old, female Sprague-Dawley/ANL rats were exposed at the Health Physics Research Reactor (DOSAR), at Oak Ridge National Laboratory, to a single whole-body dose of fission neutrons between 2.0 and 2.2 rads. 18/71 (25%) of these irradiated rats developed a mammary tumor within 450 days after exposure. During this same time only 6/101 unirradiated control rats showed any palpable spontaneous mammary tumors. These differences are highly significant ($p = < 0.01$). The results from this neutron experiment were compared with similar exposures to low LET x-irradiation. Relative biological effectiveness (RBE) for this tumor system appears to be approximately 50 at this low neutron dose. This is an extremely high value, for any mammalian system tested to date, although recent evidence indicates that this mammary tumor system may not be unique in such high RBE values after low neutron doses. More work in radiobiology, especially at low doses, is needed before neutron radiation therapy is applied to man. (GE)

16013 MORPHOLOGICAL AND BIOCHEMICAL INVESTIGATIONS INTO THE BEHAVIOR OF FIBROUS TISSUE IN RADIO-INDUCED PULMONARY FIBROSIS. Bublitz, G. Stuttgart; Thieme (1973). 62p. (In German).

Investigations were made on a total of 370 albino rats to study radioinduced late changes in the lung tissue. The animals were subjected to irradiation of the right lung lobe with a telecobalt unit, avoiding a direct irradiation of the left lung lobe. The dose applied amounted to 3,000 R. The rats were sacrificed after 24 h, 8 d, or 4 or 8 weeks post-irradiation and the lung tissue specimens were examined histologically and in the electron microscope. Biochemical investigation of the components of the connective tissue were conducted on the various collagen fractions. Based on the results of the biochemical and morphological investigations which supplement each other, four stages of the development of the radioinduced fibrosis are defined, namely: proliferation, re-formation and activation of the connective tissue cells, increase in fibroglia, synthesis of collagen precursors of small molecular size, and formation of mature collagen and formation of fiber structures. These new findings on the origin and development of the radioinduced fibrosis lead to a better understanding of the complex mechanism, and especially radiotherapists will benefit from these results which give them more insight into the effects of radiation treatments. (GE)

16014 DYNAMICS OF CHANGES IN THE STRUCTURE OF THE CARDIAC CYCLE DURING HEAD IRRADIATION IN RABBITS. Dzhanzhgava, M. M. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 3, 697-700(Sep 1973). (In Russian).

Continuous head irradiation (dose rate 350 to 400 rad per min) in rabbits brings about cardiodynamic disturbances only in the terminal stage. During this period, artificial rise of the blood pressure with intraarterial injection of polyglucin or maintaining the animals on an artificial respiration markedly normalizes the structure of the cardiac cycle. It should be pointed out that cardiodynamic disturbances are preceded by a severe hypoxia. The foregoing facts allow the conclusion that the irradiation shock caused by whole-body and the chest or head irradiation is not to be accounted for by primary cardiac insufficiency. (auth)

16015 POST-IRRADIATION EFFECTS OF PHOTOREACTIVATING LIGHT AND CAFFEINE ON CULTURED MARSUPIAL CELLS EXPOSED TO ULTRAVIOLET LIGHT. Todd, P.; Schroy, C. B.; Lebed, M. R. (Pennsylvania State Univ., University Park). Photochem. Photobiol.; 18: No. 5, 433-436(Nov 1973).

Cells from the kidney of the rat kangeroo (Potorous tidactylus) were used for in vitro studies of the postirradiation effects of photoreactivating light and caffeine. Survival curves indicated that the effect of post-uv exposure (100 ergs mm^{-2}) to photoreactivating light for 30 min was dose modifying; the ratio of doses leading to any level of damage on the two curves was nearly constant with a value of approximately 2.3 ± 0.2. Potorous cells were found to be resistant to the toxic effects of caffeine up to 4.0 mM with only moderate cell killing but long growth delay. Survival curves are presented for cells post-irradiation incubated in 1.0 mM, 1.5 mM, and 4.0 mM caffeine. Incubation for up to 60h showed no subtoxic level that significantly modifed cell survival. It is suggested that these in vitro studies indicate that the presence of photoreactivating enzyme discussed by Cooke, J. S., and Regan, J. D., (Nature 223, 1066-1067, 1969) phylogenetically parallels the presence of photoreactivation of lethal damage. (UK)

16016 BIOLOGICAL EFFECTS OF FAST NEUTRONS NOT IN CHARGED PARTICLE EQUILIBRIUM. Bewley, D. K.; McNally, N. J.; Page, B. C. (Medical Research Council, London). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

Cells from a rat tumor were exposed in vitro to a cyclotron-produced fast neutron beam of mean energy 7.5 MeV, under conditions of full and minimum secondary charged-particle equilibrium. The cells were plated on melinix discs and covered with tissue-equivalent plastic or aluminium for the two situations. When no recoil protons were present, an oxygen enhancement ratio of 1.0 was found. The dose and quality of the radiation absorbed by the cells were estimated by calculation and measurement with an ionization chamber. The dose from recoil protons increases very rapidly under the first few microns of tissue, which limits the accuracy of RBE values obtainable. Nevertheless estimates of RBE and OER have been made for the partial doses of recoil protons and heavier ions. The heavier ions were found to have a higher RBE than the recoil protons, particularly under hypoxic conditions. This technique of irradiation with fast neutrons containing a minimum contribution from recoil protons enables the experimenter to use a very densely ionizing type of radiation without having access to a beam of charged particles. (GE)

16017 SURVIVAL OF SPERMATOGONIAL STEM CELLS IN THE MOUSE AFTER EXPOSURE TO 1.0-MEV FAST NEUTRONS. de Ruiter-Bootsma, A. L. (Rijksuniversiteit, Utrecht); Kramer, M. F.; de Rooij, D. G.; Davids, J. A. G. (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Nuremberg, Germany (22 Oct 1973).

The surviving number of stem cells after irradiation was estimated by determining the fraction of repopulated tubules in cross-sections of the testis, 11 weeks after irradiation. This fraction,

called the repopulation index, is assumed to be directly proportional to the number of surviving stem cells. Groups of mice were irradiated with different doses of 1-MeV fast neutrons ranging from 200 to 410 rads. Within this dose-range the dose-response curve has an exponential slope with a D_0 of 85 rads. This value indicates the rather low radiosensitivity of spermatogonial stem cells, compared with differentiated spermatogonia and stem cells of other tissues. Two other groups of mice received doses of 900 and 1,200 rats of x rays, in order to determine the RBE of the fast neutrons used. A RBE value of 4.4 was found. The response of spermatogonial stem cells to a dose of 350 rads of fast neutrons, divided into two fractions, was studied using fractionation intervals varying between 0 to 48 hours. At all intervals repopulation indices were lower than in controls, irradiated without fractionation. The radiosensitivity of the stem cells increases sharply between 4 and 8 hours after the first irradiation. Hence, in contrast to the behavior of stem cells in other tissues investigated, spermatogonial stem cells surviving an irradiation get into a state or phase of greater radiosensitivity. (GE)

16018 CHOLESTERIN BIOSYNTHESIS IN THE LIVER OF MICE AFTER IRRADIATION WITH X RAYS AND TREATMENT WITH ACTINOMYCIN D. Heil, T. Freiburg i. B.; Univ. Freiburg i. B. (1972). 47p. (In German).

Thesis.

Male, white mice with a weight of 25 to 30 g received a single whole-body irradiation with γ rays at a dose rate of 90 R/min. The liver was removed from the etherized animals, and acetate and mevalonic acid incorporation into cholesterol was determined in the supernatant after homogenization and centrifugation of the liver. Irradiation with doses ranging from 690 to 2,000 R markedly enhanced the cholesterol synthesis from acetate and mevalonic acid. The strongest increase in cholesterol synthesis from acetate and mevalonic acid was observed 72 h after irradiation with 2,000 R. The incorporation rates for acetate and mevalonic acid were even higher than in fed mice. Radioinduced stimulation of the incorporation rate of acetate into cholesterol was much stronger than that of mevalonic acid. Results obtained for the effect of actinomycin D and irradiation on cholesterol synthesis clearly supported the findings of other authors. It is shown that the time-consuming method using liver sections can be replaced by the method described in this work, using liver homogenates, although in this case the incorporation rates are much lower than those found in liver sections. This disadvantage, however, is offset by the fact that the required calculations are less complicated. (GE)

16019 EFFECT OF GENERAL X-RAY IRRADIATION ON THE MONOAMINEOXIDASE ACTIVITY IN VARIOUS PARTS OF THE BRAIN. Goksadze, G. K. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 72: No. 3, 673-676(Dec 1973). (In Russian).

The effect of general x-ray irradiation on the monoamineoxidase activity in the cortex, thalamus, medulla, and cerebellum was studied. It was established that after x-ray irradiation the activity of general monoamineoxidase in all the studied parts of the brain at first increases, then decreases and keeps at this level over several days. Monoamineoxidase, specific to serotonin, has also been found to be highly sensitive to x rays. (auth)

16020 CHEMICAL RADIATION PROTECTION. Messerschmidt, O. Hippokrates (Stuttgart); 44: No. 1, 102-104(Mar 1973). (In German).

Chemical radiation protection in experimental animals is reviewed. Aminothiols, phosphorylated aminothiols, biogenic amines, and bacterial endotoxins are discussed. Various hypotheses about their action are presented. Clinical application in radiotherapy appears promising, but the drugs have such a high toxicity that great caution is required in their administration to human patients. (HBG)

16021 INFLUENCE OF RUTIN ON THE RAPID RECOVERY OF SUBCUTIS, AFTER RADIOGENOUS CHANGES IN PERMEABILITY FOLLOWING LOCAL IRRADIATION. Graebner, H. F.; Derichsweiler, P.; Barth, G. (Univ., Giessen, Ger.). Strahlentherapie; 146: No. 2, 226-240(1973). (In German).

On a total of 935 white mice, under a variation of radiation dose, and under an application of weals of Chinese ink at the moment of irradiation, it was demonstrated by a suspension of soot that the radiogenous disturbance of permeability in the subcutaneous connective tissue quickly recovers in a measurable course. By the use of four different irradiation doses between 125 and 1,000 R, an early recovery of the permeability can be observed between 60 and 120 min after exposure, partly with high significance, with a half-life period 1.5 hrs for the radiation doses of 125 R, 250, and 500 R. Under a superficial dose of 1,000 R, an ascertained early recovery can not be seen within 180 min. The constant influence of rutin on the early recovery is astonishing; hereby the disturbed permeability in the first 30 min after irradiation already improves with statistical significance. This also is a mathematical proof that rutin diminishes the vascular permeability, increased by irradiation. (auth)

16022 ONTOGENY OF THE MOUSE IMMUNE SYSTEM: IN VIVO AND IN VITRO STUDIES. Tyan, M. L. (Univ. of North Carolina, Chapel Hill). Sov. J. Develop. Biol. (Engl. Transl.); 3: No. 1, 19-26(1972).

Studies were conducted on the ontogeny of the immune system using the developing mouse embryo. Experiments were designed to explore the origin, distribution, and functions of the progenitors of the effector cells, the conditions necessary for the maturation and proliferation of these cells, and the nature of the interactions between various cellular and tissue components in the regulation and genetic control of the immune response. For studies on cell-bound immunity, cells from various tissues of fetal, newborn, or adult mice were injected into irradiated mice; results indicated that lymphoid stem cells with the potential to participate in cell-bound immune reactions appeared in the placenta and liver by the ninth or tenth day of gestation. Irradiated hosts were also used in experiments on antibody-producing cells and morphologic studies. Studies on maturation of cell-bound immune responses included efforts to promote the maturation of the precursor cells in thymectomized, irradiated hosts by means of irradiated and nonirradiated thymus grafts. Thymectomized mice were lethally irradiated and given liver cells from embryos of various ages for studies on antibody-mediated immune responses. Cell interactions and immunological specificity are discussed. (HLW)

16023 METABOLISM AND RELATIVE VALUES OF THE ELECTROPHORETIC FRACTIONS OF CHICKEN EMBRYO SERUM PROTEINS AS AFFECTED BY GAMMA IRRADIATION. Marinopolski, G.; Khristov, D. God. Sofii. Univ., Biol. Fak.; 64: No. 1, 261-270(1972). (In Bulgarian).

Modifications were studied that occur in the electrophoretic spectrum of serum proteins and their methionine-^{35}S inclusion on irradiation during chicken embryonal development. White Leghorn chicken embryos were used. The eggs were irradiated on the 10th and 16th day post incubation by gamma radiation at 500 and 1000 R at 500 R/min. In order to follow the influence of irradiation on serum protein metabolism, sterile physiological saline containing 10 μC methionine-^{35}S was introduced in the egg chamber at the rate of 0.5 ml, 48 hours post irradiation. Isotope presence in blood serum protein fraction was determined 1½ and 24 hours post injection by means of electrophoresis and contact autoradiography on roentgen plates. Egg irradiation both on the 10th and the 16th day post incubation resulted in serious disturbances in embryo development. Thirty-five to 50% of 1000 R-treated embryos and 15 to 20% of 500 R-treated embryos died a day or two after irradiation. A larger number of embryos died when irradiation was effected on the 10th day. There exists a definite dependence between the degree of alterations in serum protein fraction ratios and the irradiation dose. The 1000 R dose produced stronger effect than the 500 R dose. Irradiation with various gamma doses during separate stages of embryonal development led to quantitative changes in the electrophoretic spectrum of chicken embryo serum proteins. Treatment effect was more distinctly expressed on irradiation during the earlier stages of embryogenesis. Partially expressed, non-linear correlative dependence was found between the irradiation dose used and treatment effect. (INIS)

16024 REACTION OF THE HYPOTHALAMUS IN IRRADIATED ANIMALS TO VIBRATION. Minasyan, S. M. (Erevan State Univ.). Biol. Zh. Arm.; 26: No. 1, 50-56(Jan 1973). (In Russian).

The electrical activity of different structures of the hypothalamus was studied. Its increasing effect on the brain cortex due to x irradiation and vibration was studied in rabbits. At different times during radiation sickness, under vibration conditions the hypothalamus showed a normalizing effect on the brain cortex. Electrograms showed a displacement in the high-frequency direction of low-amplitude waves and a lowered threshold of stimulation of the hypothalamus due to activation of the cortex. At the end of the latent period, and especially at the peak of the sickness, the radiation factor was predominant in the response of the organism to vibration. (tr-auth)

16025 CONCENTRATION OF LEUCOGENENOL IN THE SERUM OF DOGS FOLLOWING THEIR EXPOSURE TO LETHAL γ RADIATION FROM COBALT-60. Rice, F. A.; Chen, C. G.; Rene, A. A. (American Univ., Washington, DC). Radiat. Res.; 56: No. 3, 507-512(Dec 1973).

Three male and 3 female dogs were exposed in the AFRRI whole body irradiator to 350 rads of cobalt-60 γ-radiation at approximately 39.5 rads/min. Prior to and at intervals following irradiation, a sample of serum was obtained from each dog and assayed

for its leucogenenol content. Before irradiation the average concentration of leucogenenol in the serum was 10.5 ± 6 μg/liter. The day after irradiation the average concentration in 5 dogs fell to 0.002 μg/liter and in 1 dog to 1.5 μg/liter. However, 2 days after irradiation the average concentration in all dogs was elevated to 41 ± 10 μg/liter. The concentration of leucogenenol in the serum then declined so that 7 days after irradiation it was 0.47 ± 0.24 μg/liter. Leucogenenol was not measureable (< 0.001 μg/liter) in each dog's serum for approximately 4 days before the dog died. Individual dogs survived for from 13 to 20 days after irradiation. (auth)

16026 COMBINED SURGICAL AND RADIATION INJURY. VIII. The Effect of the Gnotobiotic State on Wound Closure. Donati, R. M.; McLaughlin, M. M.; Stromberg, L. R. (St. Louis Veterans Administration Hospital). Experientia; 29: No. 11, 1388-1390(15 Nov 1973).

Germfree and conventional rats were exposed to 800 R x radiation at a dose rate of 64 R/min. Controls were Sham irradiated. Four days later, one half of each group was wounded. At two-day intervals after wounding, wound sizes were measured. Mortality data are tabulated and graphs are presented to show wound closure patterns. Results suggest that wound healing abnormalities following radiation result in part from bacterial contamination and entry of more virulent organisms due to impaired immune capability secondary to hematologic radiation injury. (HLW)

16027 EFFECT OF HIGH POTASSIUM AND CALCIUM ION CONCENTRATIONS ON MEXAMINE PROTECTION AGAINST THE DEPILATORY ACTION OF X-RAYS IN YOUNG MICE. Pospisil, M.; Netikova, J.; Vacek, A. (Inst. of Biophysics, Brno). Physiol. Bohemoslov.; 22: No. 4, 375-380(1973).

The combined effect of 5-methoxytryptamine (mexamine) and high concentration calcium and potassium ion solutions on the depilatory action of x-rays was studied in young strain C 57 Bl mice. It was found that whole body protection of their coat induced with an intraperitoneal injection of mexamine in a dose of 5 mg/kg body weight 5 min before irradiation was inhibited if the substance was administered in KCl and $CaCl_2$ solutions (291 mOsm and 582 mOsm). On injecting mexamine subcutaneously, in the same whole body coat-protective dose (5 mg/kg b.w.), in isotonic (291 mOsm) KCl and $CaCl_2$ solutions, the generalized protective effect was reduced to local extent. The effect of a smaller subcutaneous dose of mexamine (1.5 mg/kg b.w.), providing local protection only, was not influenced by the simultaneous administration of isotonic KCl solution, but was inhibited in the presence of isotopic $CaCl_2$ solution. The inhibitory influence of high potassium and calcium ion concentrations on the generalized radioprotective effects of mexamine is attributed to the influence of these ions on the neural component participating in the mechanism of the protective effect of indolylalkylamines. (auth)

16028 USE OF THE WOUND RESPONSE TO COMPARE RECOVERY OF NEUTRON OR X-IRRADIATED INTERMITOTIC (G_0) CELLS OF THE RAT LENS EPITHELIUM. Riley, E. F.; Austin, B. T.; Lindgren, A. L.; Miller, R. C. (Iowa Univ., Iowa City). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

A small puncture wound in the central zone (anterior polar region) of a rat lens epithelium caused most of the intermitotic (G_0) cells around the wound to enter the cell division cycle. A wave of ^{3}H-thymidine cell labeling (DNA synthesis) began about 14 h after wounding and mitosis began about 10 h later. Irradiation prior to wounding delayed and suppressed the response to wounding. A decreased ability to respond to wounding was utilized as an indicator of latent radiation damage and as a measure of residual damage during cellular recovery after a single dose of x rays (1,000 rad, HVL = 1 mm Cu) or fission neutrons (200 rad). When cells were tested by wounding at 1 h after x-irradiation, the wave of cell labeling was delayed 5 to 6 h and the amplitude of the wave was suppressed to about 1/6 of the amplitude of the control wave. A comparable delay and suppression of the wound response was observed at 1 h after neutron irradiation. There was a gradual increase in the amplitude of the cell labeling wave during the first 7 d after x-irradiation, but there was no corresponding increase in the amplitude of the cell labeling wave during the first week after neutron irradiation. Another criterion, the percentages of abnormal anaphase and telophase figures in responding cells, also suggested a slower recovery during the first week after neutron irradiation than during the first week after x-irradiation. The percentages decreased from 73 to 57 during the first week after x-irradiation and from 47 to 42 during the first week after neutron irradiation. By 30 days post-irradiation, the neutron irradiated cells had recovered as much as the x-irradiated cells had been able to recover. In each case, the cells were able to respond without delay, but less than the control number were able to respond at any one time. (GE)

16029 CHANGES IN RADIOSENSITIVITY OF MICE AFTER PREIRRADIATION WITH FAST NEUTRONS OR WITH X RAYS. Langendorff, H.; Langendorff, M.; Moenig, H. (Heiligenberg-Institut, Baden, Ger.). Strahlentherapie; 146: No. 3, 327-338 (Sep 1973). (In German).

The influence of pre-irradiation with fast neutrons (14.7 MeV) or with x rays (150 kV) on the radioresistance of male NMRI mice was investigated. Pre-irradiation doses of up to 200 rad were given in the case of neutrons and up to 160 R in the case of x rays. The $LD_{(50/30)}$ was determined by a second irradiation of the animals (pre-irradiated with neutrons or x rays) with fast neutrons or with x rays (mice pre-irradiated with fast neutrons) and compared with the values obtained with animals that were not irradiated before. Depending on the kind of pre- and post-irradiation and on the time interval between the irradiations, different changes in radiosensitivity were observed. As a responsible reaction mechanism, amongst others, a cooperation of hormonally influenced and enzymatically controlled processes for the whole organism is discussed. (auth)

16030 METABOLISM AND RADIOPROTECTIVE EFFECT OF AET AND MEG IN ORGANISM. Kozak, I.; Arient, M. (Karlova Univ., Prague). Strahlentherapie; 146: No. 3, 367-373 (Sep 1973).

The rate of excretion of the activity of ^{14}C-labeled AET and MEG in rats and relative representation of their metabolites in urine were studied. After the administration of aqueous solutions of AET, more than 50% of the activity administered was found as 2-AT; the rest was MEG, GED, and taurocyanamide. No 2-AT was formed after the administration of MEG. Comparing the protective efficiency of individual substances after irradiation with ^{60}Co γ rays, it was found that MEG provided the best protection. The effect of AET is approximately the sum of the effects of half doses of MEG and 2-AT. 2-AT itself provides a very slight protection. The results confirm Eldjarn-Phil's theory about the decisive effect of mixed disulfides in radioprotection. (GE)

16031 PARAMAGNETISM OF BONE IRRADIATED VIVO. Koeberle, G.; Terrile, C.; Panepucci, H. C.; Mascarenhas, S. (Univ., Sao Paulo, Brazil). An. Acad. Brasil. Cienc.; 45: No. 1, 157-160(31 Mar 1973).

Paramagnetic centers were produced in living rats by irradiating bones with x rays (100 KV). Over a period of 21 days "in situ" there was no significant change in the value of spin concentration. (auth)

16032 COMPARATIVE STUDIES ON GLYCINE (^{14}C) INCORPORATION IN LIVER PROTEINS AFTER IRRADIATION. Chobanova, D.A . (Inst. of Biochemistry, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 8, 1117-1120(1973).

The incorporation rate of glycine (^{14}C) in total protein, in protein of polysomes, and in the protein fraction of the post-ribosomal supernatant was studied in white rats following a single irradiation of the liver with an 800 R dose. The changes in glycine incorporation in liver proteins under x irradiation follows the outline of the modified metabolic path of the cysteic amino acids. On the second day after irradiation, cysteine synthesis is higher, which corresponds to the highest values of incorporation of glycine in the protein fraction of post-ribosomal supernatant. (ERB)

16033 SPONTANEOUS THYROIDITIS IN THYMECTOMIZED AND IRRADIATED WISTAR RATS. Penhale, W. J.; Farmer, A.; McKenna, R. P.; Irvine, W. J. (Royal Infirmary, Edinburgh). Clin. Exp. Immunol.; 15: No. 2, 225-236(Oct 1973).

Thyroiditis and autoantibodies to thyroglobulin were found to develop spontaneously in 60% of randomly bred Wistar rats subjected to thymectomy and whole-body irradiation after weaning. Antinuclear antibodies were found in approximately 10% of these animals. Thyroiditis was seen in rats that were whole-body irradiated without thymectomy but at a much lower incidence (22%). Control rats given irradiation to the thyroid region alone showed no such effects. The histology of the thyroid gland was similar to that seen in Hashimoto thyroiditis in man. The majority of rats that developed severe thyroiditis were found to by lymphopenic and to have negligible mitogenic responses to phytohaemagglutinin as well as other changes that in view of the thymectomy and irradiation may be considered to be indicative of impaired T cell function. It was concluded that these findings support the hypothesis that thymus-derived lymphocytes play an important part in the control of organ specific autoimmune disease. (auth)

16034 MORPHOLOGICAL CHANGES IN THE SPLEEN OF LETHALLY IRRADIATED MICE NINE DAYS AFTER THE TRANSPLANTATION OF SPLEEN CELL HOMOGENATES (FRESH AND STORED FOR DIFFERENT LENGTHS OF TIME). Viktora, L.; Zoubkova, M.; Urbankova, J. (Inst. of Hematology and Blood Transfusion, Prague). Folia Morphol. (Prague); 19: No. 4, 361-366(1971).

Haematopoiesis in the spleen, and the participation of individual blood cell components in haematopoiesis were studied in mice exposed to 700 R at a dose rate of 30 R/min on the 9th day after the transplantation of a fresh spleen cell homogenate and of spleen cell homogenates stored for 24 hours at 2 to 4°C. After transplantation erythropoiesis prevailed. The homogenate stored for 24 hours still possessed a satisfactory haematopoietic activity. A longer storage time, however, significantly reduced the activity. (Nucl. Sci. Abstr. Czech.)

16035 EFFECTS OF X RAYS AND CYTOTOXIC AGENTS ON THE CELL POPULATION OF THE CRYPTS OF THE SMALL INTESTINE IN MICE. Devik, F.; Hagen, S. (Statens Institutt for Straalehygiene, Oslo). Virchows Arch., B; 12: No. 3, 223-237 (1973).

The cell population kinetics after administration of a single dose of five chemotherapeutic agents (mechlorethamine, cyclophosphamide, hydroxyurea, methotrexate, and bleomycin) has been analyzed in sections of the crypts of the small intestine of mice, and compared to the effects of x rays. Changes in cell number, cell death, and cell production during the first days form patterns that are very different, but apparently characteristic for each agent. In experiments with multiple doses given at different intervals, the toxicity to intestinal cells was indicated by weight loss, mortality, and to some extent by cell counts. Toxicity changed with different schedules. For the two agents with phase-specificity, hydroxyurea and methotrexate, this was related to proliferation kinetics. Methotrexate seemed to prolong the cell cycle and appeared to be most toxic when given at 15 hour intervals. (GE)

16036 MORPHOMETRIC ANALYSES OF THE MICROVASCULATURE OF TUMORS DURING GROWTH AND AFTER X-IRRADIATION. Hilmas, D. E. (Army Medical Research Inst. of Infectious Diseases, Frederick, MD); Gillette, E. L. Cancer; 33: No. 1, 103-110(Jan 1974).

Morphometric methods were used to investigate changes in the microvasculature of C3H/Bi mammary carcinomas during tumor growth and following single-dose x-irradiation of 6 mm average diameter tumors. Estimates included per cent vascular volume, average vessel diameter, and mean vessel length and surface area per unit volume of viable tumor tissue. Necrotic tissue volume was quantitated also. Changes in vascular parameter estimates, particularly a decrease in vascular surface area, indicated that the microvasculature may become less capable of handling the exchange of essential nutrients at an early stage in tumor growth. Following irradiation, there was a transient improvement in colloidal-carbon-filling of tumor microvasculature, and a change in morphological character of vessels toward that seen in smaller tumors, which may improve capability for exchange of essential nutrients. The results support the conclusion that these quantitative methods are of value in studying time and dose relationships in radiotherapy or chemotherapy, particularly in conjunction with other radiobiological methods. (auth)

16037 EFFECTS OF ENDOTOXIN ON HEMATOPOIESIS IN IRRADIATED AND NONIRRADIATED W/W^v MICE. Boggs, S. S.; Wilson, S. M.; Smith, W. W. (National Cancer Inst., Bethesda, MD). Radiat. Res.; 56: No. 3, 481-493(Dec 1973).

The interaction between the genetically deficient hematopoietic stem cells of W/W^v mice and the stimulation produced by bacterial endotoxin in irradiated and nonirradiated mice was studied. Effects of 25 μg S. typhosa endotoxin injected 1 day before irradiation proved to be similar to effects in +/+ normal mice in several respects. After 300 rads survival was increased from 23% to 77%, recovery of hemoglobin concentration began on day 13 rather than day 17 and granulocyte concentrations were maintained at approximately 1500 per mm^3 compared to a drop to 350 per mm^3 on day 17 in those given no endotoxin. Erythrocytic spleen colonies were negligible whether or not endotoxin was given. Endotoxin induced granulocytic colonies in significant numbers as early as 5 days after 300 rads, but their peak number (on day 7) was comparable to that seen 4 days after 700 rads in endotoxin treated +/+ mice. Spleen and femur cells of nonirradiated W/W^v mice given nine daily endotoxin injections produced very few erythrocytic colonies on transplantation into normal irradiated recipients, but a fairly substantial number of granulocytic colonies. This number was, nevertheless, far below that for spleen or femur cells of +/+ mice. When W/W^v mice were used as recipients instead of irradiated +/+ mice cells from both normal and W/W^v failed to produce granulocytic colonies. Endotoxin acts as a stem cell and granulopoietic stimulus in W/W^v mice as it does in +/+ mice, the cellular response to this stimulus being sluggish and subnormal as it is with other stimuli in W/W^v mice. (auth)

16038 LIFE-SHORTENING OF MICE BY WHOLE- OR HALF-BODY X IRRADIATION. Sato, F.; Tsuchihashi, S.; Kawashima, N. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 2, 115-119(Jun 1973).

Four hundred seventy ddN female mice of age 10 weeks were divided into five groups: whole body exposure, head exposure, trunk exposure (chest and abdomen), lower body exposure (pelvis, legs and tail), and non-irradiated control. All the exposure groups received a single x-ray dose of 400 R under anaesthesia. The mean survival times of five groups were 46.0 ± 2.3 weeks for whole body exposure, 63.5 ± 2.3 weeks for head exposure, 51.5 ± 2.3 weeks for trunk exposure, 68.1 ± 2.4 weeks for lower body exposure and 73.8 ± 2.8 weeks for non-irradiated control. The exposure of 400 R to whole body, head, and trunk resulted in significant life-shortening from that of non-irradiated group, while the exposure to lower body did not produce any significant life-shortening. The life shortening per volume dose for head exposure group was the highest among all the exposure groups. This suggests that head (brain included) may play an important role in the radiation-induced life-shortening. (auth)

16039 AET PROTECTION IN MICE EXPOSED TO PULSED RADIATIONS AND ITS CORRELATION WITH AET–^{35}S CONTENT IN TISSUES. Antoku, S. (Hiroshima Univ.). J. Radiat. Res.; 14: No. 2, 120-125(Jun 1973).

The protective effect of AET against pulsed radiations and the distributions of AET–^{35}S in mouse tissue were studied. AET afforded protection against mortality after exposure to pulsed as well as sustained radiations. Its effectiveness was of the same extent when AET was administered during 2 to 30 minutes pre-irradiation. Administration less than one second before or after irradiation afforded no protection. The maximum content of AET–^{35}S in tissue occurred 10 to 20 minutes after the administration of ^{35}S–AET. In general, a good correlation was observed between the AET contests of tissues and the protection afforded. (auth)

16040 EFFECTS OF POTATO KALLIKREIN INHIBITOR AND S-METHYL-L-CYSTEINE SULFOXIDE ON PLASMA AND LIVER KININOGEN LEVELS OF X-IRRADIATED RATS AND EFFECTIVENESS OF THESE MATERIALS AS RADIOPROTECTORS. Kubodera, A. (Tokyo Univ.); Shikita, M.; Akaboshi, A.; Turufuji, S. J. Radiat. Res.; 14: No. 2, 126-135(Jun 1973).

The effect of radiation on kininogen (a precursor of physiologically active peptides, kinins) levels in plasma and liver was investigated. Male rats were exposed to 700 R of x rays. The kininogen level showed a 10-fold elevation in four hours after irradiation and then rapidly returned to the normal value. Effects of liver-protecting compounds, such as PKI (Potato Kallikrein Inhibitor) and MET (S-methyl-L-cysteine sulfoxide), on radio-induced elevation of kininogen levels in plasma and liver were then investigated. The elevation was strongly suppressed when the animals were treated with these compounds. When tested in mice, these compounds were effective in extending survival time after x-irradiation of 700 R. (auth)

16041 INFLUENCE OF H-2 AND NON-H-2 M LOCUS ON SPLEEN COLONY FORMATION AFTER ALLOGENEIC BONE MARROW TRANSPLANTATION IN IRRADIATED MICE, ASSAYED BY ^{59}Fe UPTAKE AND COLONY COUNTING. Pena-Martinez, J.; Huber, B.; Festenstein, H. (London Hospital Medical Coll.). Transplant. Proc.; 5: No. 4, 1393-1397(Dec 1973).

From workshop conference on the genetic determinants and mechanisms of cell-mediated immune reactions; London, England (26 Feb 1973).

Bone marrow allograft survival was studied in sublethally x-irradiated mice by counting the number of erythropoietic spleen colonies formed and estimating their growth by the uptake of ^{59}Fe. The proliferating colonies appeared as nodes on the spleen surface and the relationship between the number of colonies formed and the amount of ^{59}Fe incorporated was linear to the number of cells injected. Histological analysis showed that the colonies were mainly of hematopoietic origin. Results showed that the effects of the M locus on bone marrow allograft survival were relatively weak. (HLW)

16042 PROLIFERATIVE RESPONSE OF T LYMPHOCYTES TO ALLOANTIGENS IN IRRADIATED MICE: A MIXED LYMPHOCYTE REACTION IN VIVO. Sprent, J. (Basel Inst. for Immunology). Transplant. Proc.; 5: No. 4, 1725-1729(Dec 1973).

From 2nd international symposium on cellular aspects of transplantation; St. Paul, France (11 Jun 1973).

Studies on the mixed lymphocyte reaction are reviewed in order to draw attention to the feasibility of studying the reaction in vivo.

Experiments on the kinetics of T cell proliferation are described. Irradiated mice were injected with ^{3}H-TdR and T cells from various sources. By calculating the number of cells required to produce a certain level of ^{3}H-TdR incorporation in the spleen of recipients, the proliferative capacity of thymus cells was assessed to be 50 to 100 times less than that of thoracic duct lymphocytes. The fate and function of activated T cells are discussed. (HLW)

Invertebrates

Refer also to abstracts 15567 and 15848.

16043 DOMINANT LETHAL MUTATIONS IN INSECTS WITH HOLOKINETIC CHROMOSOMES. II. Irradiation of Sperm of Cabbage Looper. LaChance, L. E. (Metabolism and Radiation Research Lab., Fargo, ND). Contract AT(49-7)3028. Ann. Entomol. Soc. Amer.; 67: No. 1, 35-39(15 Jan 1974).

Female cabbage loopers, Trichoplusia ni, were crossed with males irradiated with 20 krad of gamma irradiation. Eggs were collected, fixed, and stained for microscopic examination after 2, 4, 24, 48, and 72 h. Many of the eggs produced by the treated females showed no sign of embryonic development. Thus, a major cause of nonhatching eggs may be failure to fertilize. Eggs that were fertilized with irradiated sperm showed slower early embryonic development that those which were fertilized by untreated sperm. No chromosomal abnormalities were apparent, and virtually all embryos developed into well-formed larvae that failed to hatch. The absence of early acting lethals may be characteristic of radiation studies with lepidopteran males. (auth)

16044 ISOLATION OF RADIATION-SENSITIVE STRAINS OF DROSOPHILA MELANOGASTER FROM NATURAL POPULATION. Sechkina, E. R. (Inst. of Nuclear Physics, Leningrad). Genetika; 9: No. 10, 160-162(Oct 1973). (In Russian).

The flies Drosophila melanogaster isolated from natural populations from Livadia (the Crimea) were used in this experiment. A simple variation of the Cy/L technique was employed to select radiation sensitive mutants. Six radiosensitive strains were isolated in a sample of about 100 mutants. (auth)

16045 STUDIES ON DETERMINATION OF A SUITABLE DOSE OF GAMMA RADIATION FOR ATTENUATION OF INDIAN STRAIN OF DICTYOCAULUS FILARIA LARVAE, IN GUINEA PIGS. Tewari, H. C.; Dhar, D. N.; Gangadhara-Rao, Y. V. B. (IVRI, Izatnagar, India). Ceylon Vet. J.; 20: No. 1-2, 3-6(1972).

Inefective larvae of D. filaria irradiated at 40, 45, and 50 kR doses of gamma rays were administered intravenously to 3 groups of guinea pigs. The 4th group was given normal non-irradiated larvae. Parasitological and pathological examinations of lungs were conducted on 5, 7, 10, and 12 days after infection. A dose of 50 kR is quite suitable for the attenuation of the Indian strain of D. filaria infective larvae for vaccine production work. (Indian Sci. Abstr.)

16046 EFFECT OF IONIZING RADIATION ON ANIMAL PARASITES. Varga, I. (Institutum Zoologiae Generalis et Parasitologiae Veterinarium, Budapest). pp 81-86 of Manual on Radiation Sterilization of Medical and Biological Materials. Vienna; International Atomic Energy Agency (1973).

Ionizing radiation has been shown to reduce the infectivity of many species of parasitic protozoa. A dose of 5 to 10 kR of x rays decreases the pathogenic effect of Eimeria tenella considerably. Satisfactory protection from normal challenge can be achieved in broiler chickens by vaccinating them with irradiated oocysts. Trypanosoma lewisi exposed to an x ray dose of 50 kR remain motile and multiply in culture but fail to produce infection in rats. The irradiated trypanosomes are effective to produce immunity to a challenge with normal trypanosomes. The highly pathogenic Trypanosoma rhodesiense lose their motility when exposed to 640 kR of γ radiation; nevertheless, the immunogenic potential of the latter parasites in mice and rats is comparable with that produced by motile trypanosomes exposed to smaller doses of γ rays. The multiplication of malaria parasites and the subsequent invasion of the plasmodia into the erythrocytes can be prevented by a suitable dose of irradiation. Inoculation of rodents with parasitized blood cells exposed to 20 kR induced immunity to lethal challenge with non-irradiated Plasmodium berghei. Encouraging results have also been obtained with Plasmodium falciparum in monkeys, which, as a result of a successful immunization with irradiated forms, survived otherwise lethal challenge with non-irradiated plasmodia. (auth)

16047 EFFECT OF DOSE RATE ON THE RADIATION SENSITIVITY OF THE WAREHOUSE PEST CALLOSOBRUCHUS MACULATUS F. Naharin, A. (Israel Atomic Energy Commission, Yavne); Calderon, M.; Kott, Y. pp 42-45 of Proceedings of the 6th National Conference of the Israel Health Physics Society. Schlesinger, T. (ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From 6th national conference of the Israel Health Physics Society; Nahal Soreq, Israel (19 Dec 1971).

The effect of different dose rates on the sensitivity to radiation of the 3 stages (egg, larva, pupa) of the warehouse pest Callosobruchus maculatus was studied. The experiments were carried out for 9 dose rates within the range 750 to 900,000 rads/h with the LD_{10} as a sensitivity criterion. A radiation dose rate effect was found in all stages after a certain dose rate threshold is reached which is specific to each stage of development. In the egg the threshold occurred at 6000 rads/h, in the larva at 12,000 rads/h, and in the pupa at 130,000 rads/h. (INIS)

Radionuclide Effects (Internal Source)

Refer also to abstract 17299.

Man

Refer also to abstracts 15566 and 16062.

16048 (LBL-2448) REPORT OF THE BIOASSAY LABORATORY, JULY 1972 THROUGH JUNE 1973. Schmidt, C. T.; Sargent, T. W.; Yaeger, D. J.; Low-Beer, A. de G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 18p. Dep. NTIS $4.00.

Bioassay measurements of internal radioactive contamination are an important part of an effective radiation safety program. At the Lawrence Berkeley Laboratory both whole-body counting and radiochemical analysis of excreta are used for this purpose. This report summarize the results of the bioassay program for fiscal year 1972 to 73. At LBL, 117 employees are requested to supply 24-hour urine samples for bioassay. Requests are generally made either once or twice per year for each employee. These persons work with, or in areas containing, unsealed radioactive materials. During the period of this report, 84 employees submitted urine samples for a 72% compliance factor. In addition to this routine program, the bioassay laboratory performs special tests in the case of actual or suspected radioactive release. Summary results of the bioassay program for fiscal 1972-1973 are presented. These include results from the routine survey program and from special tests following known or suspected radioactive releases. Two incidents involving excretion levels of ^{14}C and ^{3}H exceeding ICRP derived investigation levels are reported in detail. Accomplishments of the research and development program are also described. (CH)

16049 INDIVIDUAL MONITORING OF INTERNAL RADIATION DUE TO INTRODUCTION OF ^{210}Po IN THE BODY. Ermilov, A. P.; Margulis, U. Ya.; Khrushch, V. T. (Inst. of Biophysics of the Ministry of Public Health, Moscow). Gig. Sanit.; No. 9, 62-65 (Sep 1973). (In Russian).

Methodical problems in the individual monitoring of internal radiation from ^{210}Po in the body are analyzed and formulas are derived for the calculation of the elimination of the isotope in the urine, the dose rate, the internal radiation dose, and the total radiation dose before complete elimination of the radioisotope. (JSR)

16050 ESTIMATION OF THE ABSORBED DOSE IN PATIENTS SUBJECTED TO RENAL FUNCTION STUDIES WITH RADIOISOTOPIC TECHNIQUES. Conte, L.; Mombelli, L. (Univ., Milan). G. Fis. Sanit. Prot. Radiaz.; 16: No. 2, 59-64(1972). (In Italian).

A method was developed for the calculation of the mean dose to the whole body and to critical organs after administration of a renaltropic radioactive material. The mean dose absorbed in the irradiated region by an activity of one μCi present for one hr was calculated for ^{131}I, ^{125}I, ^{203}Hg, and ^{197}Hg for the whole body, the kidneys, gonads, and bladder and the results were tabulated. (JSR)

Animals

Refer also to abstract 15998.

16051 CARCINOGENICITY OF INHALED PLUTONIUM-238 IN THE RAT. Sanders, C. L. Jr. (Battelle Pacific Northwest Labs., Richland, WA). Radiat. Res.; 56: No. 3, 540-553(Dec 1973).

Three groups of female albino rats were exposed to an aerosol of soluble ^{238}Pu derived from crushed $^{238}PuO_2$ microspheres suspended in physiological saline. Initial alveolar burdens of ^{239}Pu were 5 nCi (Group I), 18 nCi (Group II), and 207 nCi (Group III).

Only 1% of the initial alveolar lung burden remained in the lung at 1 year, decreasing to 0.3% by 600 days after exposure. The ^{238}Pu body burden was 25% of initial alveolar burden at 1 year, decreasing to 12% by 1000 days after exposure; about half of the body burden was found in the skeleton at these times. The cumulative radiation doses to the lung at 2 years after exposure were 9 rads (I), 32 rads (II), and 375 rads (III). Unexposed controls exhibited a median survival time of 825 days as compared to experimental survival times of 650 days (I), 675 days (II), and 550 days (III). The incidence of lung tumors in controls was 1.1% as compared to incidences in ^{238}Pu-exposed rats of 6.6% (I), 20.0% (II), and 25.0% (III). The incidence of all tumors, other than mammary tumors, was 4.3% in unexposed controls, and in ^{238}Pu-exposed rats, 26.7% (I), 36.6% (II), and 46.8% (III). (auth)

16052 EFFECTS OF CONTINUOUS LOCAL IRRADIATION ON THE DIAPHYSIS OF THE RAT FEMUR. Solheim, O. P. Oslo; Universitetsforlaget (1971). 117p.

The effects of continuous local irradiation on rat bone and bone marrow were studied. Strontium-90/yttrium-90 in silver tubes was used as radioactive source and applied around the femur on the periosteum. The sources provided continuous irradiation with constant dose rates to the diaphysis. A total of 623 rats were studied. The dose rate to the marrow ranged from 0 to 73 rads/day, the irradiation time from 4 to 540 days and the subsequent observation period from 0 to 360 days. Other animals were exposed to acute irradiation with 0, 3,000, and 6,000 rads on similar fields. The dominating response to local continuous irradiation in bone was a slow disappearance of osteocytes from their lacunas. In the bone marrow the cellularity of the hematopoietic tissue became reduced at low and at dose rate dependent rates. The development of hematopoietic hypoplasia seemed to be a result of direct radiation effects and not a response to vascular radiation injury. The morphological changes of the vascular system were delayed in relation to the hematopoietic effects. The broad pattern of the radiation responses could be explained by a main direct effect, primarily upon the populations of dividing cells, and by the cytokinetic characteristics of the tissues. The responses of the individual tissues during continuous local irradiation were similar to the responses after acute irradiation. However, the responses of the bone marrow were during continuous local irradiation essentially different from those observed after acute irradiation. Tumors developed from the periosteal and endosteal surface of the bone and from vascular tissue in the bone marrow. The tumor incidence per unit area exposed was not greatly different from that often reported after internal irradiation. (auth)

16053 PROLIFERATIVE AND NEOPLASTIC CHANGES IN THE OVARIES OF HAMSTERS TREATED WITH ^{131}I AND METHYLTHIOURACIL. Christov, K.; Raichev, R. (Cancer Research Inst., Sofia). Neoplasma; 20: No. 5, 511-516(1973).

From 5th Meeting of the European Study Group for cell proliferation, Sendenfjord; Sendenfjord, Norway (27 Jun 1972).

The appearance and structure of the ovarian tumors in hamsters treated with ^{131}I and methylthiouracil alone or in combination were studied. Nodular cell proliferation and tumor growth were observed in 90% of all 131-iodine injected animals killed between the 600th and 620th day after the beginning of the experiment. The induced tumors were mainly of granulosa and granulosa-theca cell type. Diffuse hyperplasia of the ovarian mesenchymal-stromal cells in methylthiouracil and in combined 131-iodine + methylthiouracil treatment was noted. The histogenesis of the ovarian tumors and the effect of 131-iodine and methylthiouracil on the ovarian carcinogenesis in hamsters were discussed. (auth)

Plants

Refer also to abstract 16088.

Microorganisms

Refer also to abstract 15674.

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 15319, 15566, 15652, 15997, 16094, and 16095.

16054 (BNL-18401) COMPARATIVE EVALUATION OF ^{123}I AND ^{99m}Tc FOR THYROID STUDIES. Atkins, H. L.; Ansari, A. N.; Bradley-Moore, P. R.; Lambrecht, R.; Wolf, A. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 26p. (CONF-740203-1). Dep. NTIS $3.50.

From international symposium on radiopharmaceuticals; Atlanta, Georgia, USA (12 Feb 1974).

A comparative study of the metabolism of ^{123}I and ^{99m}Tc in the thyroid was made. Thirty-minute uptake curves were determined for 26 patients and comparison images were obtained at 30 minutes with ^{99m}Tc and at 30 minutes and 24 hours with ^{123}I. Both radionuclides can be used to advantage in assessing thyroid function and anatomy. The reasonable cost of ^{123}I adds to its clinical value. (HLW)

16055 (IAEA-152) THYROID RADIONUCLIDE UPTAKE MEASUREMENTS. Papers Presented at a Panel Meeting, Vienna, Austria, May 17-21, 1971. (International Atomic Energy Agency, Vienna (Austria)). 1973. 167p. (CONF-710568-).

Separate abstracts were prepared for five papers presented at the conference. Seven papers were abstracted previously for NSA. For abstract numbers of these papers see CONF-710568 in the Report Number Index. (HLW)

For abstracts of individual papers see: 16056-16060.

16056 (IAEA-152, pp 1-6) CLINICAL REQUIREMENTS FOR THYROID RADIOISOTOPE UPTAKE MEASUREMENTS. Alexander, W. D.; Shimmins, J. G. (Western Regional Hospital Board, Glasgow). 1973.

From thyroid radionuclide uptake measurements meeting; Vienna, Austria (17 May 1971).

The clinical requirements for thyroid uptake tests in relation to other tests of thyroid function are discussed with particular reference to the assessment of the response of the thyrotoxic patient to therapy. The 20-minute thyroid radioiodine uptake test is especially useful for the latter purpose since it indicates the underlying functional state of the thyroid as distinct from its rate of hormone production, can be used for repeated assessments and is itself unaffected by antithyroid drugs. (auth)

16057 (IAEA-152, pp 7-11) OBSERVATIONS ON THE RATIONALE FOR THYROID UPTAKE MEASUREMENTS: A POLEMIC. Harris, C. C.; Goodrich, J. K. (Duke Univ., Durham, NC). 1973.

From thyroid radionuclide uptake measurements meeting, Vienna, Austria (17 May 1971).

The rationale for thyroid uptake tests and the requirements that such tests should satisfy are discussed. It is concluded that extremely precise measurements of uptake are not required and that relatively simple equipment and procedures can be used. A number of requirements that should be satisfied are listed. (auth)

16058 (IAEA-152, pp 63-73) MEASUREMENT OF THE THYROID UPTAKE OF ^{99m}Tc, ^{131}I, and ^{132}I AT EARLY TIMES AFTER ISOTOPE ADMINISTRATION. Shimmins, J. G.; Alexander, W. D. (Western Regional Hospital Board, Glasgow). 1973.

From thyroid radionuclide uptake measurements meeting; Vienna, Austria (17 May 1971).

A method using a single-detector scanner for measuring the early uptake of ^{99m}Tc, ^{131}I or ^{132}I by the thyroid is described. The method was tested by comparing the uptake values obtained in 16 subjects on five occasions during the 45 minutes following administration of the tracer with those obtained on two interpolated occasions by means of a fixed collimated scintillation detector fitted with a standard thyroid collimator. In only one case was there a significant difference between the two sets of measurements. It was shown that the ^{131}I activity detected with the fixed detector was equal to that in a 15.8 cm diameter circle on the scan. The method described also permits the measurement of extrathyroidal activity. From the results of such measurements mean values for the extrathyroidal ^{99m}Tc and ^{131}I activity detected by the fixed detector at different times after administration of the tracer were calculated. These values were used to formulate equations from which the early uptake of these radionuclides can be calculated from measurements with the fixed detector, if shortage of time or other considerations preclude the use of the more accurate scanning method. (auth)

16059 (IAEA-152, pp 75-89) MEASUREMENT OF THE KINETIC CONSTANTS DESCRIBING THE THYROIDAL CONCENTRATION AND ORGANIC BINDING OF IODIDE AND PERTECHNETATE. Shimmins, J. G.; Robertson, J. W. K.; Alexander, W. D.; Lazarus, J. (Western Regional Hospital Board, Glasgow). 1973.

From thyroid radionuclide uptake measurements meeting; Vienna, Austria (17 May 1971).

Studies were conducted on the kinetics of iodide-trapping and iodine-binding by the thyroid in normal and hyperthyroid subjects based on computer analysis of the data resulting from serial ^{99m}Tc and ^{131}I uptake measurements made with a single-detector

scanner during the 45 minutes following the administration of mixed tracers. Studies were carried out on 10 normal and 4 hyperthyroid subjects to whom carbimazole had been given to block iodine-binding by the thyroid. Analysis of these data yielded values for the unidirectional iodide clearance into the thyroid and the fractional iodine-binding rate. Further studies were carried out on 15 normal and 7 hyperthyroid subjects to whom no carbimazole had been given. Analysis of these data yielded values for the unidirectional iodide clearance into the thyroid, the fractional iodide loss rate from the thyroid and the fractional iodine-binding rate. The results indicate a very significantly higher unidirectional iodide clearance and a significantly higher fractional iodine-binding rate in hyperthyroid as compared with normal subjects. No significant differences in fractional iodide loss rates were observed between the groups studied. The significance of the findings is discussed. (auth)

16060 (IAEA-152, pp 135-148) SPECTRAL REGION ASSESSMENT OF THE INFLUENCE OF THYROID DEPTH ON THYROID RADIOIODINE UPTAKE. Wellman, H. M.; Tieman, J.; Saenger, E. L. (Univ. of Cincinnati). 1973.

From thyroid radionuclide uptake measurements meeting; Vienna, Austria (17 May 1971).

A sensitive technique is described for thyroid radionuclide uptake measurements based on the use of detectors with large field of view placed in contact with the neck of the subject. The technique depends on correction of the measurements for variation in detector-to-thyroid distance, which is estimated in terms of the photo-peak to scatter ratio of the pulse-height spectrum of the scintillation detector pulses, the observed ratios being compared with those found in measurements on phantoms with "thyroids" at different depths. Two variants of the technique, one using a single-detector and the other using a dual-detector system are described. The results of comparative experimental studies of these techniques and the ORINS standard technique in ^{131}I and ^{123}I uptake measurements are presented. These indicate that the single-detector technique offers an increase in sensitivity of about 20 times and the dual-detector technique an increase of 300 to 500 times as compared with the ORINS technique with a concomitant increase in accuracy resulting from the inclusion of a correction for variation in the depth of the thyroid. The dual-detector technique is shown to offer particular promise for ^{123}I uptake measurements. A protocol for comparative studies of thyroid radionuclide uptake measurement techniques based on measurements on terminal patients is described and results obtained on a single patient presented. (auth)

16061 EFFECTS OF RADIOACTIVITY IN FISH ON HUMAN BODY. Ichikawa, T. (National Inst. of Radiological Sciences, Chiba, Japan). pp 317-351 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (Ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

Fish polluted with radioactivity was considered with special reference to the problem of safety management in effluent water. An atomic power plant in Japan stands near the coast area where fishery is engaged. Safety management should be performed to reduce effluent radioactive substances. The radiation dose (D) to critical organs when continuously ingesting fish for a long time, was shown as the following formula: D (rem/year) = maximum permissible dose to the critical organ × radioactivity in fish (μCi/g) × the amount of intake (g)/(MPC) w × 2200. (MPC)w is the maximum permissible concentration of various nuclides in drinking water. From the data obtained by environmental monitoring, the Derived Working Limit (DWL) or permissible concentration of nuclides in the seawater is used to recognize the safety in exposure to the inhabitants. Radiation doses to human organs from these results were estimated and the possibility of radioactive waste disposal in the deep sea was considered. (JA)

16062 MEDICINE IN THE MINING INDUSTRIES. Rogan, J. M. (ed.). London; William Heinemann Medical Books Ltd. (1972). 397p. pounds 4.50.

Individual chapters are devoted to: the pathology of coal pneumoconiosis; the pathology of silicosis; the pathology of asbestosis; dust inhalation, retention, and elimination; physiological aspects of dust disease; clinical aspects of respiratory disease due to mining; hazards of mining uranium and some rare ores, and the use of vibrating tools; control of dust in mines; measurement of airborne dust; radiological control of dust disease; occupational dermatitis in miners; beat diseases; extremes of temperature; mine gases; noise; accidents; emergency surgery; medical aspects of mines rescue; mine rescue breathing apparatus; personal protective equipment; ergonomics of mining; hygiene in mines; attendance and absence; rehabilitation of mineworkers; epidemiology; administration. (Occup. Saf. Health Abstr.)

16063 DIAGNOSTIC IMPORTANCE OF ^{125}I-FIBRINOGEN IN THE DETECTION OF PERIPHERAL THROMBOSES. Keszthelyi, B.; Than, Z.; Nagy, I.; Javor, T.; Kutas, V. Magy. Radiol.; 25: No. 5, 279-284(Oct 1973). (In Hungarian).

Iodine-125 labeled fibrinogen was administered intravenously to patients with thrombosis of the extremities as well as to normal individuals. There was a significant difference between the fibrinogen half-life of the normal subjects and that of subjects with recent thromboses; however, the difference was not significant between the normal subjects and those with old thromboses. In many cases the results were verified by post-mortem findings. No complications or side effects were observed following administration of the labeled fibrinogen. (HLW)

16064 ^{131}Cs AS SCANNING AGENT IN THE EVALUATION OF COLD THYROID NODULES. Bestagno, M.; Rembado, R.; Guerra, U. (Servizio di Medicina Nucleare, Brescia, Italy). J. Nucl. Biol. Med.; 17: No. 3, 111-112(1973).

Cesium-131-labeled cesium chloride was injected intravenously and thyroid scanning was performed 2 to 3 hrs later. The relative cesium uptake by the thyroid nodules recognized as cold with ^{131}I or ^{99m}Tc was quantified. When the ratio between the nodule and the normal parenchyma (N/p) was above 1.2, the nodule was classified as hot; when N/p was below 0.9 it was classified as cold. Results of 87 selected cases are tabulated. The correlation of N/p values with benign nodules, malignant nodules, and thyroiditis is discussed. (HLW)

16065 RADIOACTIVE INDIUM IS NOT READILY TRANSFERRED TO THE AMNIOTIC FLUID. Biggs, J. S. G.; Buttfield, I. H. (Univ. of Queensland, Brisbane, Australia). Aust. N. Z. J. Obstet. Gynaecol.; 13: No. 3, 163-164(Aug 1973).

Studies performed within one hour of indium-113m placental localization in eight patients showed that only about 0.01% of radioactivity had passed from maternal blood to amniotic fluid. (auth)

16066 DETERMINATION OF URANIUM IN THE RED BLOOD CELLS OF WORKERS IN THE CHEMICAL PROCESSING OF URANIUM ORE. Nosek, J.; Simkova, M.; Kukula, F.; Musil, K. Prac. Lek.; 25: No. 9, 389-391(Oct 1973). (In Czech).

Uranium was determined by the method of neutron activation analysis in red blood cells of venous blood, in control persons and in persons occupationally exposed to uranium in the chemical processing of uranium ore. A mean of 4.1 ± 2.6 ppb uranium was ascertained in the dry substance of red blood cells in the group of control persons. The following mean was ascertained in the dry substance of red blood cells in the group of persons occupationally exposed to uranium hazards: in workers at the wet chemical plants 6.5 ± 2.1 ppb uranium; in workers at the final dry plants 37.2 ± 20.2 ppb uranium. (auth)

16067 DETERMINATION OF PLUTONIUM AND AMERICIUM-241 IN SURFACE WOUNDS. Bazzarri, S.; Masi, G.; Testa, C. (CNEN, Casaccia, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 1, 7-13(1972). (In Italian).

Wound contamination is one of the more likely and dangerous routes for plutonium uptake and apparatus for its detection at superficial and subcutaneous levels is necessary. Two types of sound can be used. In the case of small skin areas, an alpha sound with 0.12 cm^2 solid-state detector offers 45% efficiency with a virtually nil alpha background and contamination of the order of 17 pCi/cm^2 can be evaluated. Subcutaneous contamination of about 150 pCi can be detected under ideal conditions with a thin NaI(Tl) crystal using a beryllium window. This will detect 17 KeV x emissions of plutonium (4% respect to the alpha d.p.m.). The surface is 5 cm^2 and efficiency compared with the alpha d.p.m. of the 239 isotope is between 0.2 and 0.7%. The background ranges from 2 to 20 cpm. The frequent presence of ^{241}Am with plutonium means that its abundant x and gamma rays increase the efficiency of the x sound. It was therefore used to prepare a calibration curve for the determination of ^{241}Am percents in plutonium and its efficiency in function of the absorbent layer and variations in such percents was calculated. (auth)

16068 ^{85}Sr RETENTION IN JAPANESE AFTER SINGLE ADMINISTRATIONS. Uchiyama, M. (National Inst. of Radiological Sciences, Chiba, Japan); Tanaka, G.; Yabumoto, E. J. Radiat. Res.; 14: No. 2, 169-179(Jun 1973).

The retention of ^{85}Sr administered intravenously or orally to 14 Japanese was studied for a period of less than one month. The whole-body retention curve, as determined from excreta, could be fitted well by a sum of two component exponential functions when the amount of ^{85}Sr exogenously excreted into the feces was excluded. However, the sizes and the rate constants of the respective components varied with individuals. The absorption coefficient of ^{85}Sr was calculated for four subjects and found to be about 50% for normal cases and 30% for subjects with osteoporosis. Cumulative urinary excretion of ^{85}Sr was not less than cumulative fecal excre-

tion for absorbed ^{85}Sr. The fractions (f_u) of the element excreted in 24 hr urine over that in 24 hr total excreta of both stable Sr and Ca, which included exogenous origins, were higher for the subjects in this study than those for the normal male adults. The fraction varied greatly day to day when the amount of stable Sr exogenously excreted into the feces was included in this calculation. A higher content of stable Sr in the excreta of the subjects in this study was generally observed in comparison with that of the normal male adults, but the amount of Ca in excreta of the subjects in this study was comparable to that of the normal male adults. (auth)

Animals

16069 STUDIES ON THE DISTRIBUTION OF RADIOISOTOPES BY WHOLE BODY AUTORADIOGRAPHY. 30. THE FATE OF ^{14}C-HOPA IN RATS AND MICE. Nakamura, S.; Takahashi, T.; Sato, Y. (Tanabe Seiyaku Co. Ltd., Toda, Japan). Bitamin; 45: No. 4, 193-200(Apr 1972). (In Japanese).

The absorption, distribution, excretion, and metabolism of ^{14}C-HOPA were studied in rats and mice following oral administration. When ^{14}C-HOPA was administered orally to rat, the radioactivity was absorbed rapidly from the digestive tract, the half-life for absorption being 110 minutes. Thirty minutes after oral administration of ^{14}C-HOPA in mice, the concentration of the radioactivity was conspicuous in the liver and kidney, and moderate in the testis, muscle and spleen, and that in the brain was extremely low. The autoradiographic distribution pattern of ^{14}C-HOPA was similar to that of intravenous route. The highest concentration of the radioactivity in the brain of rats reached 3 hours after oral administration, and the amount of HOPA was 1.4 μg per gram of the wet weight. Sixty-five percent of the radioactivity of ^{14}C-HOPA was excreted in urine of rats within 48 hours and 28.5% in feces. Ninety-eight percent of the urinary radioactivity accounted for unchanged ^{14}C-HOPA and 2.0% accounted for an unknown metabolite. (auth)

16070 ^{65}Zn METABOLISM, SECRETION INTO MILK, AND BIOLOGICAL HALF-LIFE IN LACTATING COWS. Neathery, M. W.; Miller, W. J.; Blackmon, D. M.; Gentry, R. P. (Univ. of Georgia, Athens). J. Dairy Sci.; 56: No. 12, 1526-1530(Dec1973).

Following oral dosing, zinc-65 metabolism was studied in 10 first-lactation Holstein cows during the 5th and 6th wk of an experiment in which a high beet pulp, low-zinc diet (16.6 ppM) was fed without and with (39.5 ppM total zinc) supplemental zinc. For the 14 days after dosing, cows fed low zinc had a much higher net zinc-65 absorption (53.4 versus 34.8%) and consistently secreted far more zinc-65 into milk (14.4 versus 6.3%). The zinc secreted into milk of cows fed low zinc during the 14 days had been in the body a shorter time than in controls, indicating greater dependences on recently consumed zinc for secretion into milk. The biological half-life (in lactating ruminants defined as the time required for one-half of the zinc-65 dose to leave the body via feces and milk) was shorter for the cows fed low zinc. Lactating cows are able to absorb a high percentage of dietary zinc, and lactation is a major factor in zinc metabolism and homeostasis. Major changes in zinc metabolism occur before performance is affected. (auth)

16071 UPTAKE AND ELIMINATION OF TRITIATED WATER BY FISH. Morgan, T. J. Lafayette, IN; Purdue Univ. (1973). 97p. University Microfilms Order No. 73-28,115.

Thesis (Ph. D.).

Investigations were conducted to evaluate the uptake and elimination of tritium by channel catfish, Ictalurus punctatus (Rafinesque). The uptake of tritium by bluegills, Lepomis macrochirus (Rafinesque), was also investigated. Also, various materials were evaluated as digesters for use in the preparation of fish tissue for liquid scintillation counting. Perchloric acid was found to be the most effective tissue solubilizing agent based on completeness of digestion and counting efficiency. Studies were performed on the uptake of tritium by fish exposed at water temperatures of 23.5, 28, and 31°C. The uptake rate was assumed to be exponential and a non-linear regression analysis was used to calculate the time required for the fish to reach one-half of their saturation burden of tritium. The calculated uptake times were compared using Student's "t" test at the 95% confidence level. It was determined that temperature, within the range studied, had no significant effect on the whole-body uptake rate of the fish. The mean time for the fish to reach one-half of saturation was 0.48 ± 0.05 h. The uptake rate by kidney, gill, gut, and muscle tissue was determined. The time required for catfish to eliminate one-half of their tritium burden, 0.31 ± 0.02 h, was found to be significantly different when statistically compared to the whole-body uptake half-time. The time required for bluegills to acquire one-half of a saturation burden of tritium was 1.39 ± 0.16 h, considerably longer than that required by catfish. The movement of tritiated water across a dialysis membrane was studied. It was found that the time required to reach one-half of saturation tritium concentration was 0.58 ± 0.01 h. A statistical comparison revealed a significant difference between the whole body uptake rate of the catfish compared to the movement across the dialysis membrane. (Diss. Abstr.)

16072 NEW SUBSTANCE WITH AFFINITY TO CANCER CELLS: LANTHANIDE ELEMENTS. Hisada, K. (Kanazawa Univ., Japan); Ando, A.; Hiraki, T. Rinsho Hoshasen; 18: No. 3, 185-187(Mar 1973). (In Japanese).

The citrate, chloride, or nitrate of eight lanthanide elements (^{140}La, ^{141}Ce, ^{153}Sm, ^{153}Gd, ^{160}Tb, ^{169}Yb, ^{170}Tm, and ^{177}Lu) were injected intravenously into rats with Yoshida sarcoma. At various times after injection the rats were killed and then the tumors and main organs were excised. The ratio of the uptake of each element into 1 gm of the tissue to each total administrative dosage was calculated. The uptake ratio of the tumor to other organs per unit of weight were also calculated. The uptake rate of ^{170}Tm-citrate into the tumor 24 hrs after intravenous injection was 1.34%/g and that of ^{169}Yb-chloride was 1.07%/g. These values were similar to 1.14%/g of ^{67}Ga-citrate. In the ratio of the tumor to the muscle, the tumor to the blood, and tumor to the liver, these values for ^{170}Tm and ^{169}Yb compounds were greater than that of ^{67}Ga. In the ratio of the tumor to the kidney, there was no significant difference between ^{170}Tm and ^{169}Yb compounds and ^{67}Ga. In the ratio of the tumor to the bone, these of ^{170}Tm and ^{169}Yb compounds were smaller than that of ^{67}Ga. Twenty-four hours after the intravenous injection of ^{169}Yb-citrate, the lower body of the rat was scanned by scintillation camera with pinhole-collimater for 30,000 count (992 sec). The scintigram was compared with these by ^{67}Ga-citrate for 30,000 count (284.8 sec) and by ^{111}In-citrate for 30,000 count (188.9 sec). ^{169}Yb was found mainly in the tumors and the bones, and ^{67}Ga and ^{111}In in the tumors and the soft tissues. The curve of the residual ^{169}Yb-citrate in the whole body 16 days after the intravenous injection consisted of a rapid phase and a gradual phase. Biological half-time was 9.6 hrs in the rapid phase and 60 days in the gradual phase. (JA)

16073 GASTRO-INTESTINAL ABSORPTION AND DISPOSITION OF ^{144}Ce IN MICE NEONATES CONTAMINATED BY LACTATION. Naharin, A.; Feige, Y.; Lubin, E. (Israel Atomic Energy Commission, Yavne). pp 37-41 of Proceedings of the 6th National Conference of the Israel Health Physics Society. Schlesinger, T. (Ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From 6th national conference of the Israel Health Physics Society; Nahal Soreq, Israel (19 Dec 1971).

The transfer of ^{144}Ce-nitrate from dams to neonates via lactation, the absorption of the contaminant through the intestinal wall, and the distribution to the skeleton and liver were studied. It was found that during 24 hrs suckle, when the dose is administered to the dam immediately after delivery, the transfer of the contaminant to the neonate was 8.2×10^{-4}% of the dose. This transfer reached the maximum of 1.4×10^{-3}% of the dose, when the dose was measured 12 days after delivery. It was shown that ^{144}Ce is also absorbed through the intestinal wall and that this passage is age dependent, i.e., an internal deposition of 4.5% of the G.I. tract content was observed when the dose of the dam was measured at the neonate's age of 16 days. Consequently, an age dependent discrimination mechanism against the absorption of ^{144}Ce was observed, with the ratio of absorption 10 fold higher on the 1st day of life, over that on the 16th day. The skeleton was found to be the main target organ in young mice and the ratio skeletal/liver was age dependent too, i.e., ~9.3 when dosimetry of the dam was immediately after delivery until approximately a ratio of 40 when at the age of 16 days. (auth)

16074 EXPERIMENTAL INVESTIGATION OF THE ^{119m}Sn KINETICS. Glaubitt, D.; Roedler, H. D.; Marx, R.; Schaefer, H. (Freie Univ., Berlin). (1973). vp.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

The kinetics of ^{119m}Sn were studied in male Wistar rats for a period of 19 weeks following intravenous injection of 20 μCi in the form of hexachlorostannate(IV). A slow and a rapid component of the biological half-life of ^{119m}Sn could be determined in the whole body and in five different organs. The selection factors proved to be the highest in the liver, skeleton, and kidneys of rats and also in men (in a corrected manner). The relative initial concentration of radioactive tin reached its highest values in the liver, followed by the spleen and kidneys, of both rats and man. Assuming that the distribution pattern in man of ^{113}Sn obtained by elution from generator columns is equal to that of ^{119m}Sn hexachlorostannate(IV) in rats, it is to be expected that the incorporation of ^{113}Sn eluted with ^{113m}In will mainly affect the liver, spleen, and kidneys. (GE)

16075 ACCUMULATION AND ELIMINATION OF TRITIUM IN PERORAL ADMINISTRATION OF TRITIATED ETHANOL. Moskalev, Yu. I.; Kalyazina, N. S.; Zhuravlev, V. F.; Mamrenko, G. I.;

Kalugun, S. K. (Inst. of Biophysics, Moscow). Med. Radiol.; 18: No. 10, 28-33(Oct 1973). (In Russian).

In peroral administration of tritiated ethanol in the aqueous phase of the body there was accumulated up to 58% of the introduced amount of tritium. Tritium is included into structural elements of the organs and tissue. The greatest amount of tritium is found in structural elements of muscles (2.05%). Elimination of tritium from the aqueous phase of the body occurs with periods of semielimination: $T_{\frac{1}{2}} - 0.5 = 1.1$ days. From structural elements of the body, tritium is eliminated with periods of semielimination of 1.1 days; slowly eliminating fraction (40%)—with periods of 35.4 days. The greatest concentration of tritium is in the kidneys, spleen, and the blood. During administration of tritiated ethanol, tritium is eliminated more slowly than tritium oxide. This points to the fast that the chemical form of tritium influences the kinetics of isotope metabolism in the body. (auth)

16076 RADIOAUTOGRAPHIC STUDIES OF KRYPTON-85 CLEARANCE FROM RAT INCISOR PULP AND SURROUNDING TISSUES. Fontenelle, A.; Bergeron, M. (Montreal Univ., Quebec). Arch. Oral Biol.; 18: No. 9, 1069-1076(Sep 1973).

Rats were killed by rapid freezing at various intervals following the injection of a ^{85}Kr solution in the common carotid artery. A technique is described for the preparation of 400 μm sections, perpendicular to the mandibular incisor, across the molar area and without diffusion of the radioactive gas. The contact radioautographs obtained are free of chemographic effects and are a true reflection of the tracer distribution at the time of death. The technique allows the study of ^{85}Kr partition between the pulp, the ligament, and the perimandibular soft tissues at various clearance times after ^{85}Kr injection in the ipsilateral or contralateral carotid artery. In the chosen experimental conditions, ^{85}Kr circulation is negligible and the clearance is more rapid in the pulp than in the ligament and soft tissues. The results obtained with this technique provide a foundation for the interpretation of the pulpal clearance curves recorded in vivo. (auth)

16077 DECONTAMINATION OF SWINE, SHEEP, AND CATTLE SURFACES CONTAMINATED BY FISSION PRODUCTS. I. Removal of Cs, Sr, and I Radioisotopes. Havlicek, F.; Hrusovsky, J.; Mach, J. (Vojensky Veterinarni Vyzkumny Ustav, Prague). Voj. Zdravot. Listy; 42: No. 1, 40-44(Jan 1973). (In Czech).

In experiments aiming at finding a suitable decontamination substance, complex-forming and chelating compounds, detergents and/or soap were tested for their efficiency in decontaminating domestic animals surface-contaminated by a mixture of fission products. Observed were the economy, the availability, the storage capacity, and the universality of application of the substances. Investigations were carried out on swine, sheep, and cattle (bulls). For ^{137}Cs, a decrease by more than one order was attained in surface contamination by all the substances used. A marked decontamination effect of the substances was found for ^{131}I in swine and cattle; generally smaller efficiency was observed in the elimination of ^{85}Sr. For practical use, a 1% aqueous solution of EDTA with a common household detergent (JAR-extra) was recommended as a universal decontamination means. (INIS)

16078 LONG TERM EFFECTIVE HALF-LIVES FOR LEAD-210 AND POLONIUM-210 IN SELECTED ORGANS OF THE MALE RAT. Torvik, E. (Univ. of Cincinnati); Pfitzer, E.; Kereiakes, J. G.; Blanchard, R. Health Phys.; 26: No. 1, 81-87(Jan 1974).

The influence of ^{210}Pb on the effective half life of ^{210}Po in various organs of the male rat was investigated. Male rats were injected with an equilibrium solution of RaDEF. Rats were sacrificed over 140 days post injection and skull, femur, spine, kidney, gonads, spleen, liver, lungs, blood, and heart removed, weighed, and analyzed for their ^{210}Po and ^{210}Pb content. The data indicate that soft tissue, half life and distribution values for ^{210}Po will be influenced by the release of ^{210}Po from the bone compartment. The results bring into question the MPC values for decay chains (i.e., RaDEF decay chain) in which daughter products can be redistributed to other organs thereby increasing the radiation dose to these organs. (auth)

16079 KINETICS OF ^{18}F AND ITS POSSIBLE APPLICATION IN DIAGNOSTICS OF BONE LESIONS. Kleisner, I. (Karlova Univ., Prague); Satrapa, T.; Vrana, V.; Cechova, J.; Mudrova, B.; Svoboda, K.; Hruby, J. Cas. Lek. Cesk.; 112: No. 15, 464-466(13 Apr 1973). (In Czech).

The metabolism of a carrier-free ^{18}F was studied with the aim of applying the radioisotope in diagnostics. The preparation containing ^{18}F was intravenously administered to rats and its distribution was investigated in the lungs, the spleen, skeleton muscles, in the femur and in teeth. Experiments were also carried out with dogs in which the retention was studied in the head and the spine. The head and the spine were also studied for the retention of ^{18}F in seven patients of various age and sex. The distribution analysis shows that referred to the critical organ, i.e. the bone, the optimum examination time using the radioisotope varies between the 3rd and the 6th hour after intravenous administration. (INIS)

16080 RADIOIODINE UPTAKE BY THYROID DURING LONG-TERM ADMINISTRATION OF THEOPHYLLINE IN RATS. Schreiber, V.; Kapitola, J.; Schreiberova, O. (Charles Univ., Prague). Endocrinol. Exp.; 6: No. 1, 29-32(1972).

Radioiodine (^{132}I) uptake by the thyroid in vivo was repeatedly measured in male rats during a long-term administration of 0.2% of theophylline in diet. During the first 10 days of the theophylline feeding the uptake increased to almost a double value of the initial level. Later, the level decreased and after 4 weeks it appeared to be stabilized, the values being slightly higher than in controls. It was concluded that the stimulatory effect of theophylline on the ^{132}I uptake by the thyroid was only of a transitory nature and did not persist longer than 4 weeks. (Nucl. Sci. Abstr. Czech.)

16081 DISTRIBUTION OF ^{32}P, ^{45}Ca, ^{85}Sr, AND ^{133}Ba AS A FUNCTION OF AGE IN THE MOUSE SKELETON. Stather, J. W. (National Radiological Protection Board, Harwell, Eng.). Health Phys.; 26: No. 1, 71-79(Jan 1974).

The main object of this study was to provide quantitative information on the distribution and retention of ^{32}P, ^{45}Ca, ^{85}Sr, and ^{133}Ba in the mouse skeleton as a function of age at the time of injection. At 24 hr after intraperitoneal (i.p.) injection into 8-week old mice, the distribution of four radionuclides throughout the skeleton was essentially identical. In the case of ^{85}Sr, however, the skeleton accumulated about 90% of the total body activity at this time, whereas for ^{32}P the amount was only about 40%. The levels of accumulation of activity by the bones depended upon the age of the animals at the time of injection. Thus at 24 hr after i.p. injection of ^{85}Sr into 3 and 26-week old animals the concentration of ^{85}Sr in the bones varied by factors of less than 1.5 and 5 respectively. These differences were attributed mainly to the degree of vascularization and the surface area available for absorption in individual bones. The relative concentrations of activity in the bones changed considerably with time after injection due mainly to varying rates of loss of activity from different bones. In older animals the levels of activity in the various bones became more uniform with time but in the youngest mice injected (3 weeks old) concentrations in individual bones varied by about a factor of 9 by 128 days after injection. It was also shown that in the mouse there is no significant release of ^{90}Y formed from ^{90}Sr deposited in bone. (auth)

16082 RELATIONSHIP BETWEEN ^{67}Ga-CITRATE ACCUMULATION AND CALCIUM METABOLISM IN TUMOR CELLS. Anghileri, L. J. (Univ., Essen). Nucl.-Med.; 12: No. 3, 257-265(Nov 1973).

The in vivo uptake of ^{67}Ga-citrate and ^{45}Ca-chloride by Ehrlich ascites tumor cells was studied by the "ghost cells" technique. Results indicate that approximately 50% of the intracellular ^{67}Ga is incorporated in the cellular residual material formed mainly by phospholipids, proteins, and nucleic acids. The relationship between both ^{67}Ga and ^{45}Ca incorporations is discussed. (auth)

16083 ^{67}Ga-CITRATE ACCUMULATION BY TUMORS: IMPORTANCE OF MAGNESIUM AND CALCIUM METABOLISM. Anghileri, L. J. (Univ., Essen). Strahlentherapie; 146: No. 3, 359-366(Sep 1973).

The uptake of ^{67}Ga-citrate and ^{51}Cr-citrate by experimental tumors was studied. Each radioisotope seems to be accumulated by a different process, but both mechanisms are the effects of the same cause: A modification in the metabolism of magnesium and calcium. There is evidence that the substitution of Ga^{3+} ions for Mg^{2+} ions is the principal reaction involved, and that this magnesium is bound to non-diffusible macromolecules or forms an insoluble compound. The importance of the radius-ratio effect, and of the interaction with insoluble calcium compounds in the accumulation of ^{67}Ga by tumor is discussed. The feasibility of using other radioisotopes with similar ion-substitution characteristics (such as the lanthanides) is suggested. (auth)

16084 INTESTINAL ABSORPTION OF IRON IN THE IRRADIATED RABBIT. Tache, J.; Mehran, A. R.; Tache, Y. (Univ. Laval, Quebec). Rev. Can. Biol.; 32: No. 3, 157-165(Sep 1973). (In French).

In the rabbit, irradiation in toto (^{137}Cs, 800 R and 1600 R, 4.1 R/min) decreases the accumulation of ^{59}Fe (duodenal injection of 0.06 ug of iron) in the intestinal wall and its transfer to the blood. However, at all times, a small amount of iron crosses the parietal barrier. This phenomenon is generally observed 1, 4, 7, and 13 days after irradiation. After 7 and 13 days, the intestinal ab-

sorption values in a few animals are higher than in the controls. Studies on the distribution of ^{59}Fe i.v. in tissues show that irradiation (1600 R) increases ^{59}Fe plasma iron (24 and 96 hr after exposure) and decreases haematopoiesis (as determined after 96 hr by the lack of radioactive iron incorporation into haemoglobin). Irradiation does not modify to a large extent the capacity of the duodenum to accumulate endogenous iron. (auth)

16085 DISTRIBUTION OF ^{90}Sr AND ^{137}Cs IN POULTRY AND IN HENS' EGGS. Csupka, S. (Obiastna Hygienicka Stanica, Bratislava). Biologia (Bratislava); 28: No. 2, 139-144(1973).

The distribution of ^{90}Sr and ^{137}Cs in poultry and in hens' eggs was studied in birds fed with contaminated food. Out of the total content of radiostrontium and radiocaesium, 77.9% of ^{90}Sr was ascertained in bones and 94.2% of ^{137}Cs was observed in flesh. In eggs ^{90}Sr was found to accumulate mainly in shells, while ^{137}Cs was more or less equally distributed in the white and the yolk of a fresh-laid egg. (INIS)

16086 WHOLE-BODY RETENTION OF ^{65}Zn AFTER SINGLE AND DAILY ORAL ADMINISTRATION IN YOUNG AND ADULT MICE. Matsusaka, N. (Iwate Univ., Morioka, Japan). J. Radiat. Res.; 14: No. 2, 180-186(Jun 1973).

The whole-body retention of ^{65}Zn in the young and adult mice after single and daily oral administration was investigated. The retention values for ^{65}Zn in young mice were significantly higher than those of the old ones. Since significant differences were noted in the presence or absence of the fast declining component of the retention curves and since the final slopes of ^{65}Zn retention curves were similar among all the age groups, the higher retention of ^{65}Zn in the 7- and 14-day-old mice was probably attributed to its near-complete absorption from the gastrointestinal tract, while the 21-day-old and adult mice absorbed 45 and 12% of the administered dose, respectively. It is also noted that the 7-day-old mice contained significantly higher ^{65}Zn in the pelt and lower ^{65}Zn in pancreas, liver and gastrointestinal tract than those of the adult mice. When ^{65}Zn was administered orally every day over a period of two weeks, the young animals retained 50% of the administered dose at the termination of administration, while the adult retained 8%. Again, its difference could be attributed to an efficient intestinal absorption of young animals. (auth)

16087 MECHANISM OF UPTAKE OF GALLIUM-67 IN TUMOR CELLS. Higasi, T. (Kanagawa Dental Coll., Yokosuka, Japan); Nakayama, Y.; Akiba, C.; Hisada, T.; Fields, M. H. Radioisotopes (Tokyo); 22: No. 6, 291-296(Jun 1973).

Electron microscopic autoradiograms demonstrated that the cytoplasmic ^{67}Ga is mainly associated with the cell membrane and the mitochondria. Intracellularly the mitochondrial and microsomal fractions contained 34.8% and 20.5% of the activity respectively. In vitro, Ehrlich's tumor cells with either cell membranes damaged by EDTA or altered chemical function by an anticancer agent showed a significant decrease in ^{67}Ga uptake. (auth)

Plants

16088 URANIUM CONTENT IN PLANTS: A PRELIMINARY REPORT. Nagpal, M. K.; Nagpaul, K. K.; Bhan, A. K. (Kurukshetra Univ., India). Curr. Sci. (India); 43: No. 1, 8-9(5 Jan 1974).

Sixteen plant species from different ecological habitats at Kurukshetra were studied in an attempt to correlate the uranium content to the plant habitat. The uranium content, determined by fission track technique, varied from 0.8 to 26.7 ppM. Internally borne uranium could possibly cause spontaneous mutations in organisms. (LK)

16089 DEFORMATION OF CELL SHAPE AND PIT PATTERN IN ROOTS OF ZEA MAYS UNDER THE INFLUENCE OF COLCHICINE AND HEAVY WATER. Stein, O. L.; Rowley, J. R.; Lockhart, J. A. (Univ. of Massachusetts, Amherst). Phytomorphology; 21: No. 4, 296-308(Dec 1972).

Individual files of xylary elements, representing the progeny of a single meristematic cell, were used in the analysis of treatments designed to cause cell distortion. Changes in cell dimensions and pit distortion patterns resulting from treatment with colchicine or heavy water were examined. Colchicine treatment produced shortened, spheroidal cells of increased volumes as compared to water-grown controls, whereas D_2O-treated cells were shortened cylinders. Some striking effects on pitting pattern were found. Cells showing the greatest colchicine effect had walls with relatively normal pits. Cells exposed only at the termination of their development showed some longitudinal fusion of pit patterns. When cells were exposed to heavy water, pits appeared as transverse or longitudinal grooves. On theoretical grounds a model is proposed that would account for the cell deformations observed. This model involves consideration of cellulose cross-link breakage, polymer synthesis, and orientation of new wall elements. Cell file scoring increases the precision of ontogenetic analyses by taking advantage of the fact that one deals with the serial progeny of a single cell before, during, and after treatment and thereby eliminates the complications of competition and cell displacement commonly encountered in complex tissues. (auth)

Microorganisms

16090 GROWTH PATTERN AND $^{13}C/^{12}C$ ISOTOPE FRACTIONATION OF CYANIDIUM CALDARIUM AND HOT SPRING ALGAL MATS. Seckbach, J.; Kaplan, I. R. (Hebrew Univ., Jerusalem). Chem. Geol.; 12: No. 3, 161-169(Nov 1973).

A study was undertaken with the thermophilic green alga Cyanidium caldarium, which grows optimally at low pH and high concentrations of CO_2. Carbon-isotope fractionation was not found to be a simple linear function of temperature. Maximum enrichment of ^{12}C in cellular material occurred under optimum growth conditions (at approximately pH 2 and at temperatures between 40 and 50°C in a CO_2 atmosphere). A maximum measured fractionation of $-24‰$ may account for low values ($\delta\,^{13}C < -30‰_{PDB}$) in Precambrian kerogen presumably derived from algal mats. (auth)

16091 ^{90}Sr UPTAKE IN A MARINE ALGA (CHLAMYDOMONAS). I. Rossi-Torelli, M.; Polese, E.; Del Bianchi, S. (CAMEN, Pisa, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 1, 14-19(1972). (In Italian).

A Chlamydomonas marine strain was cultured in the presence of ^{90}Sr and ^{90}Y. No difference in growth rhythm was noticed when 1 m μC ^{90}Sr was employed and an uptake maximum was observed on the 6th or 7th day, at which point the ^{90}Sr-^{90}Y ratio (in no. of atoms) was 30:1. Individual cell uptake of ^{90}Sr was around $128 \cdot 10^{-9}$ from the 8th day. Comparison of the amount of ^{90}Sr present in the algae (dry weight) and in an equivalent amount of earth showed a concentration factor of about 1600. (auth)

New Tracer Techniques

Refer also to abstracts 15210–15226, 15228, 15229, 15232, 15859, 16042, 16076, 17703, 17985, 17987, and 17989.

16092 (BNL-50381) RESEARCH APPLICATIONS OF SYNCHROTRON RADIATION. Proceedings of a Study-Symposium Held at Brookhaven National Laboratory, September 25–28, 1972. Watson, R. E.; Perlman, M. L. (eds.). (Brookhaven National Lab., Upton, N. Y. (USA)). Jun 1973. Contract AT(30-1)-16. 211p. (CONF-7209107-). Dep. NTIS $12.75.

The conference covers biological diffraction, x-ray diffraction in biology, protein structure determination by diffraction, x-ray microscopy, uv absorption studies on biophysical systems, biological responses to ionizing radiations, holography, far ultraviolet photochemistry, free atoms and molecules, x-ray astronomy. (JFP)

16093 (CENA-BT-1) POSSIBILITY OF REPLACEMENT OF A GEIGER–MUELLER DETECTOR BY A LIQUID SCINTILLATOR IN MEASURING THE RADIOACTIVITY OF THE AFRICAN BEE APIS MELLIFERA ADANSONI (L), LABELLED WITH ^{32}P. Nascimento Filho, V. F.; Wiendl, F. M. (Centro de Energia Nuclear na Agricultura, Sao Paulo (Brazil)). Jun 1972. 38p. (In Portuguese). INIS.

A comparative study is presented on the use of Geiger detectors and liquid scintillators for the detection of bees labeled with ^{32}P. From the results it is concluded that the substitution of GM counters is recommended because it gives great efficiency. The main advantage is the use of smaller concentration of radioisotopes. (INIS)

16094 UPTAKE OF TRITIATED THYMIDINE IN THE HAMSTER CERVIX DURING THE ESTROUS CYCLE. Belch, R. Z. Chicago; Univ. of Illinois (1972). 98p. University Microfilms Order No. 73-29,338.

Thesis (Ph. D.).

Cyclic events in the gross and microscopic morphology of the golden hamster's uterine cervix were investigated at each of ten specific times during the estrous cycle. Autoradiographic techniques were employed to ascertain cyclicity of normal cell renewal during the estrous cycle in the epithelium, connective tissue, and smooth muscle of the cervix. Young virgin female hamsters were injected with tritiated thymidine one hour prior to necropsy at specific stages. Thymidine indices for the various cell populations were calculated. There was cell renewal in each of the populations studied during all of the observed stages. The epithelium was most active in thymidine incorporation. There

was uniform activity at the various levels of the cervix and it was biphasic, one peak occurring late in Day 4 and the other early in Day 2. Basal cell contribution to epithelial renewal occurred throughout the estrous cycle. In addition, thymidine incorporation into parabasal cells was observed from late Day 1 until the epithelium of the cervix had sloughed late in Day 2. Cyclicity in connective tissue and smooth muscle cell renewal was also observed; maximal activity in both occurred during the second half of Day 1. (Diss. Abstr.)

16095 CELLULAR UPTAKE OF BIOLOGICALLY-ACTIVE POLYRIBOINOSINIC-POLYRIBOCYTIDYLIC ACID. Kelly, T. A. New York; New York Medical Coll. (1973). 68p. University Microfilms Order No. 73-31,025.

Thesis (Ph. D.).

The cellular uptake of a small percentage of radioactive Poly I:C has been reported. However, the question of whether or not this uptake represented intact, double-stranded, biologically active (capable of interferon induction) Poly I:C or "biologically inactive," oligonucleotide fragments of Poly I:C has not been definitely answered. An attempt was made to answer this question by means of a sensitive biological assay. Rabbit kidney cells were exposed to Poly I:C, the cellular RNA was extracted, and tested biologically in rat embryo cells for the presence of Poly I:C. In no case was Poly I:C detectable in the cell RNA. In other experiments utilizing Poly I:^{3}H-C acid-precipitable radioactive material was found in cells extracted with trichloroacetic acid. The results of a polyacrylamide gel electrophoretic analysis of the RNA from cells exposed to Poly I:^{3}H-C indicated that the bulk of the acid-insoluble radioactivity recovered from these cells represented incorporation into cellular RNA of the hydrolysis products of the radioactive Poly I:^{3}H-C. (Diss. Abstr.)

16096 SIMULTANEOUS SCINTIPHOTOGRAPHY AND RADIONEPHROGRAPHY IN EXPANSIVE RENAL LESIONS. Tori, G.; Bistaffa, R.; Marabini, A.; Franchi, R. (Univ., Bologna). Radiol. Med.; 59: No. 9, 814-828(Sep 1973). (In Italian).

Simultaneous ^{131}I Hippuran and ^{203}Hg chlormerodrin scintiphotography and $^{99m}TcO_4^-$ angioscintiphotography, using a gamma camera, gave useful information concerning the nature of space-occupying renal lesions in 61 patients. (auth)

16097 RADIOISOTOPES IN THE STUDY OF THE LIVER AND THE BILIARY DUCTS. Meldolesi, U. (Univ., Milan). Radiol. Med.; 59: No. 9, 829-854(Sep 1973). (In Italian).

Methods for radioisotope study of the liver and the biliary ducts are reviewed and their diagnostic utility is discussed. Particular attention is given to liver scintiscans with colloids and positive tracers, determination of hepatic circulation flow from colloidal ^{198}Au clearance, and the study of liver and biliary function with radioactive Rose Bengal. (auth)

16098 UTILIZATION OF X RAYS AND RADIOACTIVE ISOTOPE IN ICHTHIOLOGY AND FISHERY SCIENCE. Ichikawa, T. (National Inst. of Radiological Sciences, Chiba, Japan); Eto, K.; Taguchi, Y.; Egami, N. pp 352-378 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (Ed.). Tokyo; Koseiska Kosei Kaku (1973). (In Japanese).

The utilization of x rays and radioactive isotopes other than in the medical field was classified and described. Application of radiography to taxonomical and morphological study of fishes was very useful, and the results were most satisfactory when the fish was 2 to 20 cm long. Radiography was only one method to know internal morphology when anatomical study was not permitted; in comparing the differences of the number of the vertebra between populations of different species or those among certain species, in cases of investigating the location of bones, and in counting the number of strands of fins. The disadvantage of radiography for fishes was that the region in which bones overlapped, and the soft tissue such as the tendon, and muscle could be hardly read. Soft x-ray radiography and special methods of radiography are described. Application of radioisotopes (^{3}H, ^{137}Cs, ^{60}Co, and ^{65}Zn) was also useful for the physiological and biochemical studies of fishes, and for the ecological investigation studies of fishes as natural resources. The activable tracer method was also used. Other utilization of radioisotopes was measurement of digestion and absorption rate of feedstuff in the cultivated fishes, determination of pollution of natural environment by hazardous substances, such as heavy metals, agricultural medicines, and bacteria, and x-ray irradiation for preservation of fishery materials because of its bactericidal action. (JA)

16099 SUPERSENSITIVE RADIOIMMUNODIFFUSION METHOD OF ANTIGEN DETERMINATION. Abelev, G. I. (Inst. of Epidemiology and Microbiology, Moscow). Byull. Eksp. Biol. Med.; 74: No. 11, 122-125(Nov 1973). (In Russian).

A method of determination of antigens is described, that of electrophoresis-precipitation in polyacrylamide gel (EPAG) permitting an immunodiffusion identification of the antigen with a sensitivity 2000 to 5000 times exceeding the precipitation sensitivity in agar. In the EPAG the antigen under study was polymerized in gel of 4% polyacrylamide (PAAG), and concentrated 30 times during electrophoresis. The antigen was included in 7% PAAG in the form of narrow (1 mm) zone. The antigen zone was revealed by the precipitation in gel reaction, carried out directly in 7% PAAG. To increase the sensitivity of determinations the test-system giving invisible precipitation bands is used. This reaction is expressed by the treatment of gel plate with ^{125}I or ^{131}I antibodies to γ-globulin of the immune serum with subsequent autoradiography. The method was used in determination of α-phetoprotein. Its sensitivity with the test-system detected by simple staining constituted $4 \cdot 10^{-2}$ mkg/ml, and in combination with immunoautoradiography $-3 \cdot 10^{4}$ $-6 \cdot 10^{4}$ mkg/ml. (auth)

16100 MODIFICATION OF RADIOCOMPETITIVE BINDING TECHNIQUE FOR SERIAL MEASUREMENTS OF TOTAL BLOOD THYROXINE LEVEL. Klimaszewski, J.; Reklewska, B.; Kaciuba-Uscilko, H. (Inst. of Genetics and Animal Breeding, Jastrzebiec, Poland). Acta Physiol. Pol.; 24: No. 5, 677-684(1973).

The modification described allows serial estimations of the total blood thyroxine level to be made within a shorter period of time in comparison with original methods. Performance of a large number of determinations is facilitated by some easily made or commercially available devices. Accuracy of the procedure is improved by precise weighing of the ion-exchange resin, dispension of the solutions used with a micro-dose pump and establishment of time when the equilibrium of the reaction is reached. Results of the blood thyroxine concentration, measured by the method described, in some species of animals and in euthyroid human subjects are presented. (auth)

16101 DETERMINATION OF IRON ABSORPTION FROM WHOLE DIET. A New Two-Pool Model Using Two Radioiron Isotopes Given as Haem and Non-haem Iron. Hallberg, L. (Goteborg Univ.); Bjoern-Rasmussen, E. Scand. J. Haematol.; 9: No. 9, 193-197(1972).

Preliminary data strongly indicate that there is a complete isotopic exchange between an added inorganic iron tracer and non-haem iron compounds in a number of foodstuffs when thoroughly mixed with the food during preparation. The absorption of such a tracer is expected to give a true measure of the total absorption of non-haem iron from the diet. Similarly there is evidence indicating that radioiron-labeled hemoglobin may be used as a tracer for studies on haem iron absorption from the diet. A two-pool model is suggested for food iron absorption—one haem iron and one non-haem iron pool. These pools can be independently labeled with an inorganic radioiron tracer and with radioiron-labeled hemoglobin by using two different radioiron isotopes. The total absorption of iron from these pools (from the whole diet) can be measured from the combined measurement of total body retention of ^{59}Fe using whole body counting and determination of the ratio ^{55}Fe/^{59}Fe in a blood sample. A report of preliminary studies on the application of this method in normal and iron deficient men is also given. (auth)

16102 SCINTIGRAPHIC DIAGNOSIS OF GASTRIC CARCINOMA. Czerniak, D. (Sheba Medical Center, Tel Hashomer, Israel). Harefuah; 83: No. 12, 518-525(Sep 1972). (In Hebrew).

During the past 10 years efforts have been made to develop a radioisotope test for gastric malignancy. Phosphorus-32 was used by intracavity procedures (gastric tube-detector; autoradiography) but the procedures were difficult. In 1961 the first scintillographic assays with scanners and then with scintillation cameras were performed. Iodine-131 was used at first and since 1965 ^{99m}Tc, which is superior from a physical point of view. It was established that a cold space-occupying lesion in the gastroscan indicates malignancy and that a foggy scan, general or local, may also indicate a neoplastic lesion. All other conditions, including peptic ulcer and gastritis, give a normal scan. In the dog, injection of ^{99m}Tc indicated a turnover of the isotope in the body, and that it is concentrated in the gastric mucosa and excreted in the gastric juice. A gastroscintillographic study in 220 patients showed that 54 of them had stomach malignancies (51 carcinoma and 3 sarcoma). Only neoplasms at least 2 cm in diameter were visualized. In all the patients, clinical, radiological, and biochemical examinations were performed and in most, pathological examinations as well. There was correspondence with the final diagnosis in 80% of the scintillographed cancers and in 92% of those studied roentgenologically. The false scintillographic diagnosed conclusions were mostly in different patients than in those with false roentgenological diagnoses. It can therefore be concluded that the two methods are complementary. The radiological exposure due to ^{99m}Tc scintivisualization is low, 200 mrad to the stomach and 15 mrad to the whole body. (INIS)

16103 DIRECT PLASMA TESTOSTERONE RADIOIMMUNOASSAY. Castro, A.; Shih, H.; Chung, A. (United Medical Labs., Inc., Portland, OR). Experimenta; 29: No. 11, 1447-1448(15 Nov 1973).

A simple method was developed for determining testosterone in the plasma without column chromatography. Purification was accomplished by pre-extraction with hexane. An antiserum against testosterone was produced in rabbits inoculated with a conjugate of testosterone-3-oxine and bovine serum albumin. (auth)

16104 DESIGN OF EXPERIMENTS USING ISOTOPES FOR THE DETERMINATION OF THE RATES OF DISPOSAL OF BLOOD-BORNE SUBSTRATES IN VIVO WITH SPECIAL REFERENCE TO GLUCOSE, KETONE BODIES, FREE FATTY ACIDS, AND PROTEINS. Heath, D. F.; Barton, R. N. (Medical Research Council, Carshalton, Eng.). Biophys. J.; 136: No. 3, 503-518(Nov 1973).

The two well-known methods of estimating rates of irreversible (R) of blood-borne substrates in vivo by isotope experiments involve estimating the specific radioactivity (S) of the substrate in blood either after single intravenous injection of labeled substrate or during its infusion at a constant rate. The value of R is calculated from the S-time curve, usually by assuming: (i) a metabolic steady state with respect to substrate, (ii) the passage of all substrate through the blood, and (iii) the absence of certain types of recycling via blood. In a theoretical investigation, it is shown how experiments can be performed and R calculated from analyses of blood when one or more of the above assumptions is unjustified, by using glucose, ketone bodies, plasma free fatty acids, and proteins as examples. It is pointed out that in general the methods require single injection procedures, with estimation of the total quantity of label in the substrate in blood and the substrate concentration instead of only S. Such values give estimates of R with standard errors even when only one blood specimen is taken from each of a group of animals, as is convenient when working with small animals or substrates in low concentration, and when the animals are in a non-steady state in which constant infusion procedures are invalid. Similar methods give the fraction of label injected as one compound that passes through another (the isotopic yield). It is shown that the methods are not always applicable, and cannot be applied to plasma proteins in some pathological conditions. A questionnaire for assessing their applicability is given. (auth)

16105 RADIOIMMUNOASSAY FOR ALDOSTERONE WITHOUT CHROMATOGRAPHY. Determination of Urinary 18-Glucuronide Excretion. Vetter, W. (Univ., Zurich); Vetter, H.; Siegenthaler, W. Acta Endocrinol.; 74: 548-557(1973).

A radioimmunoassay for the determination of urinary aldosterone-18-glucuronide was developed for the clinical laboratory. Ten ml of urine is pre-extracted with methylene chloride and then submitted to acid hydrolysis. This is followed by a second methylene chloride extraction. The aldosterone concentration in these extracts is determined with antisera obtained from rabbits immunized with an aldosterone-oxime bovine gamma globulin conjugate. In view of the high recovery of [1,2-^{3}H] aldosterone, no internal indicator standards were used. The sensitivity of the overall assay was 0.44 μg/24 h. The coefficient of variation was 3.7% within a single assay and 13.6% for multiple assays. The specificity of the method was examined by comparison with a double isotope dilution derivative method and by simultaneous use of six different antisera. Under normal sodium intake the urinary excretion of the acid-labile aldosterone-18-glucuronide ranged from 4.0 to 13.0 μg 24 h in nine normal male subjects. (auth)

16106 DIRECT RADIO-IMMUNE ASSAY ON ANTIGENS AND THEIR ANTIBODIES. Ling, C. M. (to Abbott Labs.). German Patent 2,262,413. 5 Jul 1973. 13p. (In German).

A diagnostic process was developed to carry out a radioimmunoassay on antigens and their antibodies along with a process to produce a coating for the device used in this test. In particular, the discovery concerns a direct process to determine hepatitis-associated antigens and their antibodies as well as a process to produce a diagnostic device for this experiment. With the given discoveries, the lack of reproducible results and accuracy of such an investigation was overcome. The process according to the discovery consists in bringing a sample of an unknown serum into contact with an apparatus having an antibody coating and allowing an incubation time of ½ to 42 hrs, then sucking it off and washing it. Then an I-125 as tracer-contained antibody is brought into contact with the serum and the coated apparatus with an incubation time of 1 to 6 hrs, sucked off and washed and the I-125 gamma radiation of the device is counted. (GE)

16107 KINETIC BLURRING IN HEPATIC SCANNING. Use of an Original Correction Method. Sabatier, J. P.; Demeyer, G.; Thouin, A.; Ferte, J. F.; Fernandez, Y. (Centre Hospitalier Universitaire, Caen, France). J. Biol. Med. Nucl.; 8: No. 32, 22-27(1973). (In French).

Breathing can result in a blurring of scintigrams of organs affected. A correction method is presented. A fixed probe provided with a collimator is placed under the examination table in such a way that the upper edge of the liver is in its field of view. This probe provides a signal enabling the motion of the organ to be assessed. The computer processing of information obtained from this signal enables a correction to be made for the motion due to breathing. An image processing system utilizing this method of correction is currently being developed. (FR)

16108 TIME NECESSARY FOR THE HOMOGENEOUS MIXING OF LABELED RED CELLS. Morin, P. P.; Lahellec, M.; Morin, J. F.; Caroff, J.; Savina, A. (Hopital A, Brest, France). J. Biol. Med. Nucl.; 8: No. 32, 28-32(1973). (In French).

The results of 200 human kinetic studies performed simultaneously using ^{99m}Tc labeled erythrocytes and ^{131}I-labeled albumin were analyzed, the second tracer serving as a comparison element. (FR)

16109 CLINICAL EVALUATION OF RADIOISOTOPE IMAGING FOR NEOPLASTIC SKELETAL DISEASES. Kawana, M.; Hiromichi, A.; Hirotake, K. (Chiba Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 8, 661-670(Aug 1973). (In Japanese).

The usefulness of ^{18}F as a bone tumor scanning agent was evaluated. Routine bone scanning has been carried out with ^{87m}Sr and a conventional rectilinear scanner for several years. Comparative studies between ^{18}F and ^{87m}Sr were performed in twenty-eight cases, including twelve cases of primary skeletal neoplasms, fifteen cases of metastatic-skeletal neoplasms, and one case of skeletal inflammation. In case of ^{87m}Sr scans, it takes a longer time for radioactivity to clear from the blood and soft tissues compared with ^{18}F cases. So in general the body background activity is larger in ^{87m}Sr scans. But in all cases scans were positive both with ^{18}F and ^{87m}Sr. We conclude that ^{18}F scanning appears to be a very sensitive indicator in detecting bone tumors. (auth)

16110 SYSTEM FOR PRODUCING COLOR SCINTIGRAMS AFTER RECORDING AND DATA PROCESSING. de Saint-Laurent, J. (Centre Hospitalier Universitaire Saint-Antoine, Paris). J. Biol. Med. Nucl.; 8: No. 32, 16-21(1973). (In French).

A system consisting of a masked color cathode ray tube (of the type currently used in color television), a set of deflection and convergence circuits functioning at low and variable speeds, and a color encoding circuit producing seven separate colors from an analogue input voltage is described. (FR)

16111 ROLE OF NUCLEAR DATA IN THE USE OF RADIOACTIVE TRACERS IN MEDICINE. Kellershohn, C.; Comar, D. (CEN, Orsay, France). pp 287-311 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

Nuclear data fundamental for the use of radioisotopes as tracers in medical diagnostic tests are reviewed. After an introductory part on the production of radioisotopes, problems concerning their use for functional exploration, as kinetic studies, and dosimetry are considered. The last part of the paper deals with the analysis of the elementary composition of biological materials using radioactivation analysis in vitro and in vivo, the latter also concerning dosimetric problems connected with the nature of the particles used for irradiation. (auth)

16112 NUCLEAR CONSTANTS IN PHARMACOPOEIAS: THEIR USEFULNESS IN THE STANDARDIZATION OF PHARMACEUTICAL SUBSTANCES. Cohen, Y. (CEN, Saclay, France). pp 351-357 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

The radioisotope-labeled compounds administered to man are considered by national and international authorities (Council of Europe, World Health Organization) to be medicinal preparations. As such, they appear in national, regional, and international pharmacopoeias under the heading "radiopharmaceutical substances". The preparation of monographs by groups comprising physicists, doctors, and pharmacists has shown that it is often necessary to refer to precise nuclear constants, for pharmacopoeias are acquiring regulatory and legislative force, whereby they may be quoted in courts of law. Mention is made in such monographs of national radioactivity metrology laboratories which provide standards to which reference is made in the standardization of radiopharmaceutical substances as regards the radionuclide purity, concentration of the principal radionuclide,

and radioactive concentration. These monographs indicate the radioactive half-life, the nature of the radioactive emissions, and the most characteristic radiations (with their energies). They also indicate what contaminating radionuclides accompany the principal radionuclide, and establish upper limits for the concentration of such contaminants. Such information requires the establishment of tables of generally accepted nuclear constants, which will be possible only if metrology laboratories collaborate. Such laboratories could furnish the authors of monographs with physical data for inclusion in the pharmacopoeias when periodic revisions are made. A standardization of nuclear constants and co-ordination of the work of different laboratories would be useful in the case of all radionuclides. (auth)

16113 STATISTICAL ANALYSIS OF RADIOIMMUNOASSAY. In Comparison With Bioassay. Nakano, R. (Kobe Univ., Japan). Horumon To Rinsho; 21: No. 1, 53-57(Jan 1973). (In Japanese).

Using the data of RIA (radioimmunoassay), statistical procedures for dealing with two problems of the linearization of dose response curve and calculation of relative potency were described. There were three methods for linearization of dose response curve of RIA. In each method, the following parameters were shown on the horizontal and vertical axis: dose x, $(B/T)^{-1}$; $c/x + c$, B/T (C: dose which makes B/T 50%); log x, logit B/T. Among them, the last method seems to be most practical. The statistical procedures for bioassay were employed for calculating the relative potency of unknown samples compared to the standard samples from dose response curves of standard and unknown samples using regression coefficient. It is desirable that relative potency is calculated by plotting more than 5 points in the standard curve and plotting more than 2 points in unknown samples. For examining the statistical limit of precision of measurement, LH activity of gonadotropin in urine was measured and relative potency, precision coefficient and the upper and lower limits of relative potency at 95% confidence limit were calculated. On the other hand, bioassay (by the ovarian ascorbic acid reduction method and anteriol lobe of prostate weighing method) was done in the same samples, and the precision was compared with that of RIA. In these examinations, the upper and lower limits of the relative potency at 95% confidence limit were near each other, while in bioassay, a considerable difference was observed between the upper and lower limits. The necessity of standardization and systematization of the statistical procedures for increasing the precision of RIA was pointed out. (JA)

16114 DETECTION OF A PROTEIN OF AVIAN LEUKOVIRUSES IN UNINFECTED CHICK CELLS BY RADIOIMMUNOASSAY. Chen, J. H.; Hanafusa, H. (Rockefeller Univ., New York). J. Virol.; 13: No. 2, 340-346(Feb 1974).

A radioimmunoassay (RIA) was used to measure the quantity of protein P27 (mol wt 27,000; group specific-1 [gs-1]) of avian leukoviruses in different types of chicken embryos and tissues of adult chickens. The RIA used was 200- to 300-fold more sensitive than the complement fixation test and was able to detect as little as 0.3 ng of P27. Among six embryos tested, which are negative for gs antigen by the complement fixation test, P27 was undetectable in three embryos, but another three contained about 5 ng of P27 per mg of cell protein by RIA. The amount of P27 in gs antigen-positive cells ranged from 22 to 57 ng per mg of cell protein. P27 was found in liver, lung, ovary, feather pulp, and spleen from adult gs antigen-positive chickens. This protein was undetectable in various tissues from gs antigen-negative chickens. (auth)

MATERIALS

16115 DEPTH DISTRIBUTIONS OF IMPLANTED ATOMS UNDER INFLUENCE OF SURFACE EROSION AND DIFFUSION. Biersack, J. P. (New York Univ., NY). Radiat. Eff.; 19: No. 4, 249-256(Aug 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Sep 1972).

Shallow range distributions are altered significantly by diffusion and surface erosion. It is shown the simultaneous processes of implantation, diffusion, and surface erosion can be described by a second-order differential equation which is mathematically tractable and yields general results in terms of analytical functions. The resulting depth distributions depend on one parameter only which is a combination of the mean particle range, the diffusion coefficient, and the velocity of surface erosion (e.g., sputtering). The theory is applied to practical cases, e.g., implantation of plasma particles in the wall of fusion reactors, or solar wind ions in the surface of meteorite materials. (auth)

16116 HOT-ISOSTATIC PROCESSING REACHES MATURITY. Hanes, H. D. (Battelle Columbus Labs., OH). SAMPE Quart.; 5: No. 2, 1-9(Jan 1974).

The historical development of hot-isostatic processing (HIP) from the original Battelle patent to current production capabilities in the United States is reviewed. Three major applications of the process are powder consolidation, isostatic-diffusion bonding (gas-pressure or thermovac bonding), and healing of defects in cast structures. The state of the art is reviewed and production applications and recent developments are described. Facilities are being expanded at Battelle-Columbus Laboratories to provide the ability to handle workpieces up to 4 ft diameter by 10 ft long. Likely future applications of these expanded capabilities are also reviewed in this presentation. (9 figures, 23 references) (auth)

16117 KINETICS AND MECHANISM OF THE COHESION OF SOLDERLESS METAL-TO-CERAMIC SEALS. Heidt, G.; Heimke, G. (Deutsche Steinzeug- und Kunstoffwarenfabrik, Mannheim, Ger.). Ber. Deut. Keram. Ges.; 50: No. 9, 303-307(1973). (In German).

With the help of kinetic and optical methods of investigation, the cohesion mechanism in the bonding systems Ta/Al_2O_3, Cu/Al_2O_3, and Al/Al_2O_3 were examined. In the case of tantalum, the bonding is achieved by a solid-state reaction; with copper the kinetics are strongly influenced by the decomposition of the oxide layer, but the chief factor is the formation of the contact surface by means of surface diffusion and plastic flow. The latter phenomenon alone determines the kinetics in the case of aluminium. Therefore the valence forces for the systems Cu/ and Al/Al_2O_3 were considered. Covalent bonding was conjectured. Also a specific property of the system Al/Al_2O_3 can be explained by the different surface roughnesses of the two types of aluminium oxide used, sapphire and sintered Al_2O_3. (GE)

16118 IZMERENIE TEPLOPROVODNOSTI TVERDYKH TEL. (Measurement of the Thermal Conductivity of Solids). Kharlamov, A. G. Moscow; Atomizdat (1973). 152p. (In Russian).

The methodical questions of the measurement of the thermal and temperature conductivity of solids including conditions of reactor radiation and shielded chambers are examined. A classification of the methods for the determination of the thermal conductivity coefficient was proposed. Questions on the rated characteristics of irradiated substances, sample materials, and experimental results are discussed. The requirements imposed on methods of remote measurement, devices for studies inside the reactor, methods for the control of the temperature levels, and temperature measurements in the presence of reactor radiation are examined. (319 references, 31 figures) (tr-auth)

Ceramics and Cermets

Refer also to abstracts 15243–15245, 15341–15344, 15417, 15433, 15657, 16123, 16226, 16303, 16315, 16339, 16340, 17371, 17563, 17573, 17574, 17605, 17627, 18000, 18002, 18003, and 18013.

16119 (AAEC/E-231) THERMAL SHOCK TESTING OF CERAMIC BALLS REPRESENTING PEBBLE BED REACTOR FUEL ELEMENTS. Whatham, J. F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

A number of sintered ceramic BeO balls were heated and then quenched in fast-flowing CO_2 gas to determine the thermal stress that would crack similar balls containing a small amount of UO_2 fuel in the core of a prospective pebble-bed nuclear reactor. The stress to crack the average ball was determined using simplifying assumptions, and as the balls are quenched in groups this stress will be used to calculate the allowable heat output of fuel balls in a pebble-bed reactor. (auth)

16120 (AERE-R-7539) IRRADIATION EFFECTS IN CERAMICS. Matthews, J. R.; Potter, P. E. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1973. 16p. (CONF-730972-1). Dep. NTIS (U. S. Sales Only) $3.00.

From seventh international congress on the science of ceramics; Juan-les-Pins, France (24 Sep 1973).

The behavior of ceramic materials under fast-neutron irradiation is described, with emphasis on dimensional changes and the chemical effect of nuclear-reaction products. The damage processes and the behavior of point defects are outlined for a material with two components. The behavior of fissile materials is dealt within two parts: (i) The redistribution of oxide fast-reactor fuel constituents and the distribution and chemical form of fission products in oxide, carbide, and nitride fuels are reviewed. (ii) A brief description is given of the current understanding of swelling from gaseous fission products. Then the use of B_4C as neutron absorber material is described, followed by a shorter discussion on the potential use of rare earth oxides. Finally, radiation damage in potential ceramic structural materials is assessed. (auth)

16121 (CEA-R-4503) SYNTHESIS OF RARE EARTH COMPOUNDS CONTAINING TRIVALENT EUROPIUM AND PROMETHIUM-147 IONS AND THE STUDY OF LUMINESCENCE UNDER β^- EXCITATION. Babusiaux, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). Dec 1973. 67p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Paris Univ. (France).

Yttrium vanadate and lanthanum oxysulfide doped with 4% europium were studied. Between 0.1 and 1% promethium in the form of Pm^{3+} was included. The energy of the β^- particles emitted excites fluorescence emission from the europium. In the case of yttrium vanadate, doped with only promethium, this process plays the role of both activator and excitor in the luminescence process. The visible spectrum of the Pm^{3+} ion presents only weak lines. In contrast, in the near-infrared, three series of intense narrow lines occur that correspond to transitions from the $^5F_1$ level to the $^5I_4$, $^5I_5$, and $^5I_6$ ground levels. $^5F_1 \rightarrow {}^5I_4$: 8100 Å, 8200 Å, 8300 Å; $^5F_1 \rightarrow {}^5I_5$: 9400 Å, 9600 Å; $^5F_1 \rightarrow {}^5I_6$: 11,100 Å. The principal $^5F_1 \rightarrow {}^5I_5$ line occurring at 0.94 μ might lead to a stimulated coherent emission similar to that of neodymium. The development of promethium lasers functioning either with monocrystals or with solutions can thus be envisaged. (auth)

16122 (GEAP-12428) FISSION GAS RE-SOLUTION RATES. Final Report June 30, 1973. Marlowe, M. O. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Nuclear Center). Jun 1973. Contract AT(04-3)-189. 47p. Dep. NTIS $4.50.

The re-solution of fission-gas bubbles during irradiation of uranium dioxide was investigated. Fission gas bubbles were developed by post-irradiation annealing after low-temperature irradiation. The bubble size distributions were characterized and found to be log-normal. The total fission-gas content of the bubbles was estimated and found to be only a small fraction of the total fission-gas content after annealing at 1600°C for 1 hour. The effect of curvature on the surface energy of UO_2 was considered and may be the source of anomalously high estimates of the gas content of bubble population reported in the literature. Re-irradiation of irradiated and annealed specimens showed a change in the bubble size distribution consistent with an instantaneous bubble-dispersal mechanism that is considerably less effective for bubbles larger than ~100 to 300 Å. The fission-gas re-solution rate parameter, b, was found to be 2.7×10^{-4} sec^{-1}, which is at the midpoint of the range of limiting values previously reported. (17 figures, 48 references) (auth)

16123 (GEMP-174) EVALUATION OF BeO FUEL ELEMENT CONTAINING A STABILIZED FUEL ADDITIVE. Muehlenkamp, G. T. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 28 May 1963. Contract AT(40-1)-2847. 18p. Dep. NTIS $3.00.

Declassified Oct 1972.

The evaluation of a ceramic fuel tube composed of BeO plus 6 or 10 wt % UO_2 added as the stabilized fuel admixture, $45UO_2-55Y_2O_3$, is presented. Dimensional stability was excellent for thermal treatments at temperatures up to 1510°C in ambient air for 500 h and in

other environments up to 1480°C at 300 psi. The modulus of rupture strength is decreased ~32% by thermal aging in air at 1090 to 1510°C because of oxidation of the fuel phase. Recovery of the loss in strength occurs with additional time at temperatures of 1370 or 1510°C. The effect of oxidation in decreasing the modulus of rupture was reversed by reduction in hydrogen. As-fabricated modulus of rupture and crushing strength were good; the modulus of rupture strength at room temperature was 37,000 psi with a minimum strength of 23,000 psi at 1510°C. Compressive creep strength was fair with a deformation of 5.5% in 200 hours at 1510°C under a 250-psi stress. (auth)

16124 (GEMP-345-B) HIGHLIGHTS OF GE-NMPO RESEARCH (CY 1964). Part B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 1 Mar 1965. 7p. Dep. NTIS $3.00.

Declassified 21 Sep 1973.

Research on materials and components for high-temperature reactors is summarized. The work is centered on studies of substoichiometric urania and urania solid solutions above 1800°C and their compatibility with refractory metals; development of refractory-metal fuel element materials capable of operation above 1800°C in nonoxidizing atmospheres; development of reactor control, reflector, and shield materials, stabilization of UO_2 in ceramic fuel elements to extend high-temperature high-burnup capabilities; stability of high-melting carbides and borides in high-temperature gaseous environments; and coated-fuel particle development and evaluation. (JRD)

16125 (GEMP-400-B) HIGH-TEMPERATURE MATERIALS COMPONENT PROGRAMS, PART B. Fifth Annual Report. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 28 Feb 1966. Contract AT(40-1)-2847. 166p. Dep. NTIS $10.50.

Declassified 21 Sep 1973.

Results of research and development on reactor materials are summarized. Information is included on studies of substoichiometric urania and urania solid solutions above 1800°C and their compatibility with refractory metals, development of refractory-metal fuel element materials for operation in nonoxidizing atmospheres, studies of specific materials property data for various refractory metals and alloys and refractory-metal–UO_2 composites, studies of the effects of high fuel burnup on Y_2O_3-stabilized UO_2 and BeO-stabilized fuel materials, development of new, fueled and unfueled, clad metal hydrides, control elements, and shield materials, studies of physico-chemical properties of refractory carbides for reactor fuel and structure applications, and high-flux reactor gaseous fuel materials research. (auth)

16126 (GEMP-600(Vol.6)) 710 HIGH-TEMPERATURE GAS REACTOR PROGRAM SUMMARY REPORT. Volume VI. Fuel Element Drawings and Manufacturing Specifications. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 1967. Contract AT(40-1)-2847. 262p. Dep. NTIS $15.25.

Declassified 4 Sep 1973.

Drawings and process specifications for the fabrication of W–Re–Mo-clad fuel elements developed under the 710 High-Temperature Gas Reactor Program are presented. Also included is a description of the facilities and equipment used for fabricating these fuel elements. (auth)

16127 (GEMP-1011) AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM. Eighth Annual Report. (General Electric Co., Cincinnati, Ohio (USA). Missile and Space Div.). 28 Feb 1969. Contract AT(40-1)-2847. 160p. Dep. NTIS $10.00.

Declassified 21 Sep 1973.

Results of studies conducted to determine the physico-chemical relations involved in the use of U-base fuels are presented along with results of programs devoted to the development of refractory-metal fuel elements for high-temperature reactors operating in vacuum or nonoxidizing atmospheres. Activities in programs to test and evaluate clad UO_2–metal cermet fuels at high burnups are also reported along with results of studies on fission-product transport in refractory fuel systems. (JRD)

16128 (GERHTR-45) STRUCTURE OF PROPENE-PYROCARBON COATING LAYERS ON COATED NUCLEAR FUEL PARTICLES AND THEIR MODIFICATION BY ANNEALING. Gyarmati, E.; Koizlik, K.; Gupta, A. K. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe). Sep 1971. 30p. (JUL-795-RW). Dep. NTIS $3.50.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

Propene pyrocarbon both in the form of flat layers and also as a coating on ThO_2–UO_2 fuel particles was irradiated in the BR-2 reactor in Mol (Belgium) in a neutron flux of 6.4×10^{21} cm^{-2} (E > 0.1 MeV) and to a burnup of the fuel kernels of 14% fissions per initial metal atom (fima), then heat treated. Results show that, as a consequence of the heat treatment, the orientation anisotropy of pyrocarbon increases. The rapid growth of the orientation anisotropy can be explained by the generation of strong tensions having long ranges in the pyrocarbon coating. There exists a density range (approximately 1.7 g/cm^{-3}) in which there appear only very small anisotropy increases by heat treatment below 2000°C. The increase of the anisotropy is higher if the anisotropy of the starting material increases and its apparent crystallite size decreases. (auth)

16129 (GERHTR-47) INVESTIGATIONS TO DECREASE THE RELEASE OF SOLID FISSION PRODUCTS FROM COATED FUEL PARTICLES BY THE ADDITION OF REFRACTORY OXIDES TO THE FUEL KERNEL. Foerthmann, R.; Hamesch, M.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe). May 1972. 42p. (JUL-846-RW). Dep. NTIS $4.25.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

For increasing the retention of solid fission products in coated fuel particles, investigations were made on oxide fuel kernels containing special refractory oxides, e.g., Al_2O_3. It was the aim of this work to test the possibility of retaining solid fission products in the kernel by formation of stable ternary oxides. Using an hydrolysis process, UO_2 and $(U,Th)O_2$ kernels were prepared that contain the solid fission products Sr, Ba, and Ce in concentrations corresponding to a burnup of about 10% fissions per initial metal atom (fima). After an out-of-pile heat treatment of these kernels, the fission-product release is measured. The Sr release at 1250°C is found to be smaller if the kernels contain Al_2O_3 in amounts of 1 to 5 wt%. The solid fission products are enriched in the inclusions of Al_2O_3, which is not soluble in the UO_2 matrix of the kernel. (auth)

16130 (GERHTR-70) MODEL INVESTIGATIONS OF CONICAL FLUIDIZED BEDS FOR THE COATING OF NUCLEAR FUEL PARTICLES. Wallroth, C. F.; Gyarmati, E.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). 1971. 23p. Dep. NTIS $3.25.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

Nuclear fuel particles are pyrolytically coated in conical fluidized beds at temperatures of up to over 2000°C, so that it is impossible to observe the movements directly. Bases are set forth for performing model tests at room temperature to simulate the movements and an account given of measurements with the solid–gas system petunia seeds/hydrogen, using a 2-channel nozzle system. The different gas distribution between the central and annular nozzles enables different types of movement to be set up. Coating tests showed that undisturbed bubble movement gave the relatively best results as regards uniformity of depositions. (15 figures) (auth)

16131 (GERHTR-79) STUDIES ON THE PRODUCTION OF SPHERICAL FUEL PARTICLES BY A SOL-GEL PROCESS. Foerthmann, R.; Naoumidis, A.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). Mar 1969. 50p. Dep. NTIS $4.50.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

By means of "internal gelling" in the production of spherical gel particles from a suitable UO_2 sol, it was possible to obtain dense UO_2 kernels with diameters of more than 1000 μm. The individual process stages, such as sol production, gelling of the sol to spherical particles, drying and sintering, and the required apparatus are described. The process is equally suitable for the production of $(U,Th)O_2$ and ThO_2 kernels. The sols and gels produced were characterized by chemical analysis, viscosity crystallite size from widening of x-ray interference lines, and electron microscopy. Kernel parameters, such as diameter, density, and porosity, are described as a function of the gelling and sintering conditions. The process is not only suitable for the production of oxide but also of carbide spherical fuel kernels. Conditions are described for the formation both of UC_2 kernels and also of single-phase U(C,N) kernels. (11 figures, 32 references) (DLC)

16132 (IAE-2227) THERMAL CONDUCTIVITY OF URANIUM DIOXIDE. Kolyadin, V. I.; Il'in, E. P.; Kharlamov, A. G.; Yakovlev, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 36p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

A survey is given of the literature data on thermal conductivity of UO_2 at temperatures up to ~2800°K. On the basis of the analysis and generalization of the data, a relationship for dependence of thermal conductivity on temperature is proposed. Techniques and

methods used for the experimental verification of this dependence are described. The thermal conductivity of polycrystalline UO_2 of stoichiometric composition was measured in the temperature range from 300 to 2600°K. (6 tables, 21 figures, 74 references) (tr-auth)

16133 (LA-UR-73-1724) LOW-TEMPERATURE THERMAL EXPANSION OF MANGANESE DIBORIDE. Bowman, A. L.; Nereson, N. G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 4p. (CONF-731118-2). Dep. NTIS $3.00.

From international symposium on thermal expansion of solids; Lake of the Ozarks, Missouri, USA (7 Nov 1973).

The anisotropic thermal expansion of manganese diboride was determined by neutron diffraction over the temperature range 5 to 298°K. The variation of lattice parameter with temperature is defined by the equations $a = 3.0044 + 4.9 \times 10^{-6}$ T and $c = 3.0358 - 2 \times 10^{-6}$ T $+ 7 \times 10^{-8}$ T^2. The c parameter is found to contract initially, passing through a minimum at 14°K. (auth)

16134 (N-73-14707) EVALUATION OF CRYOGENIC INSULATION MATERIALS AND COMPOSITES FOR USE IN NUCLEAR RADIATION ENVIRONMENTS. Bullock, R. E. (General Dynamics Corp., Fort Worth, Tex. (USA). Convair Aerospace Div.). Dec 1972. Contract NAS8-18024. 179p. (NASA-CR-2162; FZK-385; FZK-386; FZK-387; FZK-388; FZK-389). NTIS.

The following subjects are studied: (1) composite materials tests; (2) test of liquid level sensors and fission couples; (3) test of valve-seal materials; (4) boron epoxy composites; (5) radiation analysis of explosive materials and bifuels for RNS applications; and (6) test of thermal insulation. (STAR)

16135 (N-73-14708) EXAMINATION OF UC-ZrC AFTER LONG-TERM IRRADIATION AT THERMIONIC TEMPERATURE. Yang, L.; Johnson, H. O. (Gulf General Atomic Co., San Diego, Calif. (USA)). 21 Dec 1972. Contract NAS3-15323. 150p. (NASA-CR-120995; GULF-GA-A-12237). NTIS.

Two fluoride tungsten clad UC-ZrC fueled capsules, designated as V-2C and V-2D, were examined in a hot cell after irradiation in NASA Plum Brook Reactor at a maximum cladding temperature of 1930°K for 11,089 and 12,031 hours to burnups of 3×10^{20} and 2.1×10^{20} fission/cm^3, respectively. Percentage of fission gas release from the fuel material was measured by radiochemical means. Cladding deformation, fuel-cladding interaction and microstructures of fuel, cladding, and fuel-cladding interface were studied metallographically. Compositions of dispersions in fuel, fuel matrix, and fuel-cladding interaction layer were analyzed by electron microprobe techniques. Axial and radial distributions of burnup were determined by gamma-scan, autoradiography, and isotopic burnup analysis. The results are presented and discussed in conjunction with the requirements of thermionic fuel elements for space power application. (STAR)

16136 (N-73-21470) URANIUM NITRIDE BEHAVIOR AT THERMIONIC TEMPERATURES. Phillips, W. M. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Apr 1973. Contract NAS7-100. 22p. (NASA-CR-131520; JPL-TM-33-602). NTIS.

The feasibility of using uranium nitride for in-core thermionic applications was evaluated in electrically heated thermal gradient tests and in flat plate thermionic converters. Results from these tests indicated that grain-boundary penetration of uranium nitride into both tungsten and rhenium occurs under thermal gradient conditions. In the case of the tungsten thermionic converter, this led to grain boundary rupture of the emitter and almost total loss of electrical output from the converter. It appears that uranium nitride is unsuitable for thermionic applications at the 2000°K temperatures used in these tests. (STAR)

16137 (N-73-22535) INVESTIGATION OF THE FRACTURE MECHANICS OF BORIDE COMPOSITES. Clougherty, E. V.; Pober, R. L.; Kaufman, L. (Manlabs, Inc., Cambridge, Mass. (USA)). Sep 1972. 105p. (NASA-CR-131877). NTIS.

Significant results were obtained in fabrication studies of the role of metallic additives of Zr, Ti, Ni, Fe, and Cr on the densification of ZrB_2. All elemental additions lower the processing temperatures required to effect full densification of ZrB_2. Each addition effects enhanced densification by a clearly distinguishable and different mechanism and the resulting fabricated materials are different. A significant improvement in strength and fracture toughness was obtained for the ZrB_2/Ti composition. Mechanical characterization studies for the ZrB_2/SiC/C composites and the new ZrB_2/metal materials produced data relevant to the effect of impacting load on measured impact energies, a specimen configuration for which controlled fracture could occur in a suitably hard testing apparatus, and fracture strength data. Controlled fracture-indicative of measurable fracture toughness-was obtained for the ZrB_2-SiC-C composite, and a ZrB_2/Ti composite fabricated from ZrB_2 with an addition of 30 weight per cent Ti. The increased strength and toughness of the ZrB_2/Ti composite are consistent with the presence of a significantly large amount of a fine grained acicular phase formed by reaction of Ti with ZrB_2 during processing. (STAR)

16138 (N-73-22625) EXFILE: A PROGRAM FOR COMPILING IRRADIATION DATA ON UN AND UC FUEL PINS. Mayer, J. T.; Smith, R. L.; Weinstein, M. B.; Davison, H. W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). May 1973. 53p. (NASA-TM-X-68226). NTIS.

A FORTRAN-4 computer program for handling fuel pin data is described. Its main features include standardized output, easy access for data manipulation, and tabulation of important material property data. An additional feature allows simplified preparation of input decks for a fuel swelling computer code (CYGRO-2). Data from over 300 high temperature nitride- and carbide-based fuel-pin irradiations are listed. (STAR)

16139 (N-73-30537) EFFECT OF THERMAL CYCLING ON STRUCTURE AND PROPERTIES OF A Co, Cr, Ni-TaC DIRECTIONALLY SOLIDIFIED EUTECTIC COMPOSITE. Dunlevey, F. M.; Wallace, J. F. (Case Western Reserve Univ., Cleveland, Ohio (USA)). 1 Sep 1973. 79p. (NASA-CR-121249). NTIS $6.00.

The effect of thermal cycling on the structure and properties of a cobalt, chromium, nickel, tantalum carbide directionally solidified eutectic composite is reported. It was determined that the stress rupture properties of the alloy were decreased by the thermal cycling. The loss in stress rupture properties varied with the number of cycles with the loss in properties after about 200 cycles being relatively high. The formation of serrations and the resulting changes in the mechanical properties of the material are discussed. (STAR)

16140 (N-73-30658) CARBIDE FUEL PIN AND CAPSULE DESIGN FOR IRRADIATIONS AT THERMIONIC TEMPERATURES. Siegel, B. L.; Slaby, J. G.; Mattson, W. F.; Dilanni, D. C. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Sep 1973. 16p. (NASA-TM-X-2887; E-7493). NTIS $2.75.

The design of a capsule assembly to evaluate tungsten-emitter-carbide-fuel combinations for thermionic fuel elements is presented. An inpile fuel pin evaluation program concerned with clad temperature, neutron spectrum, carbide fuel composition, fuel geometry, flux density, and clad thickness is discussed. The capsule design was a compromise involving considerations between heat transfer, instrumentation, materials compatibility, and test location. Heat-transfer calculations were instrumental in determining the method of support of the fuel pin to minimize axial temperature variations. The capsule design was easily fabricable and utilized existing state-of-the-art experience from previous programs. (STAR)

16141 (N-73-30659) UNRESTRAINED SWELLING OF URANIUM NITRIDE FUEL IRRADIATED AT TEMPERATURES RANGING FROM 1100 TO 1400 K. Rohal, R. G.; Tambling, T. N. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Sep 1973. 15p. (NASA-TM-X-2907; E-7464). NTIS $3.00.

Six fuel pins were assembled, encapsulated, and irradiated in the Plum Brook Reactor. The fuel pins employed uranium mononitride (UN) in a stainless steel (type 304L) clad. The pins were irradiated for approximately 4000 hours to burnups of about 2.0 atom percent uranium. The average clad surface temperature during irradiation was about 1100°K. Since stainless steel has a very low creep strength relative to that of UN at this temperature, these tests simulated unrestrained swelling of UN. The tests results indicated that at 1 percent uranium atom burnup the unrestrained diametrical swelling of UN is about 0.5, 0.8, and 1.0 percent at 1223, 1264, and 1306°K, respectively. The test results also indicated that the irradiation induced swelling of unrestrained UN fuel pellets appears to be isotropic. (STAR)

16142 (N-73-31614) IRRADIATION OF THREE T-111 CLAD URANIUM NITRIDE FUEL PINS FOR 8070 HOURS AT 990°C. Slaby, J. G.; Siegel, B. L.; Gedeon, L.; Galbo, R. J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Oct 1973. 39p. (NASA-TM-X-2878; E-7474). NTIS $3.00.

The design and successful operation of three tantalum alloy (Ta-8 W-2 Hf) clad uranium mononitride (UN) fuel pins irradiated for 8070 h at 990°C are described. Two pin diameters having measured burnups of 0.47 and 0.90 uranium at. % were tested. No clad failures or swelling was detected; however, postirradiation clad samples tested failed with 1% strain. The fuel density decrease was 2%, and the fission gas release was less than 0.05%,

isotropic fuel swelling, which averaged about 0.5%, was less than fuel pin assembly clearances. Thus, the clad was not strained. Thermocouples with a modified hot zone operated at average temperatures to 1100°C without failure. Factors that influence the ability to maintain uniform clad temperature as well as the results of the heat-transfer calculations are discussed. (STAR)

16143 (SLL-73-5265) EFFECTS OF ^{60}Co GAMMA-RAY IRRADIATION ON OPTICAL PROPERTIES OF NATURAL AND SYNTHETIC QUARTZ FROM 85 TO 300K. Mattern, P. L.; Lengweiler, K.; Levy, P. W. (Sandia Labs., Livermore, Calif. (USA)). Jun 1973. Contract AT(29-1)-789. 28p. (CONF-730671-1). Dep. NTIS $3.50.

From 27th annual frequency control symposium; Cherry Hill, Pennsylvania, USA (Jun 1973).

To obtain information on the mechanisms by which point defects and trapped charge concentrations affect quartz resonators, optical absorption and luminescence measurements were made on both natural and synthetic quartz, during and after ^{60}Co irradiation. Results show that many of the acoustic properties of irradiated quartz resonators may be accounted for by radiation-induced alterations of point defects in the quartz lattice. In particular, variation in frequency and Q induced by radiation at room temperature may be a direct result of changes in the anelastic absorption spectrum at low temperatures. It is also likely that the optical absorption and luminescence data reported are related directly to these same processes. (JRD)

16144 REVERSIBLE AND IRREVERSIBLE ADSORBTION OF DIFFERENT ADSORBATES ON THE SURFACE OF Mn, U, AND V OXIDES. Mardaleishvili, R. E.; Daneliya, A. P. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 5, 507-516(1973). (In Russian).

The reversible and irreversible adsorption of the adsorbates N_2 (−220°), Ar (−196°), and NH_3 (+25°) on manganese (MnO_2, MnO), uranium (UO_3, U_3O_8, UO_2), and vanadium (V_2O_5, V_2O_3) oxides was studied. The irreversible adsorption of these adsorbates was found to take place on the Me-sites of adsorption and only for the higher and intermediate oxides on the same portion of the O-sites also. (auth)

16145 PROCESS FOR THE PRODUCTION OF OXIDE AND CARBIDE CONTAINING NUCLEAR FUEL PARTICLES FOR HIGH TEMPERATURE REACTORS. Hackstein, K. G.; Kadner, M.; Foerster, H. (to Nukem Nuklear-Chemie und- Metallurgie, GmbH). US Patent 3,781,216. 25 Dec 1973. Priority date 28 Jul 1970, F.R. Germany. 6p.

Spherical oxide or carbide fuel particles of uranium and/or thorium are formed by dropping an aqueous salt solution of the heavy metal, e.g., uranyl and/or thorium nitrate into an alkaline, preferably ammoniacal, precipitation bath. The solution also includes an organic polymer, preferably polyvinyl alcohol or partially hydrolyzed polyvinyl acetate, which delays the precipitation of the heavy metal compound in an alkaline medium. The polymer must be able to maintain the surface tension in spite of the precipitation of the uranium or thorium. The polymer is precipitated by an alcohol, e.g., primary or isopropyl alcohol followed by conventional drying, hardening, calcining, and sintering or melting the product. (Official Gazette)

16146 DENSIFYING METAL HYDRIDES WITH HIGH TEMPERATURE AND PRESSURE. Niebylski, L. M. (to Ethyl Corp.). US Patent 3,784,682. 8 Jan 1974. Filed date 9 Apr 1968. 12p.

A method of increasing the density of a hydride of a metal of Groups II-A, II-B, III-A, and III-B of the periodic table comprises subjecting a hydride to a pressure of from 50,000 to 900,000 psi at or above the fusion temperature of the hydride, i.e., between 65 to 325°C. Beryllium hydride obtained from this process has a density of at least 0.69 g/cc. (Official Gazette)

16147 ELECTRIC AND MAGNETIC PROPERTIES OF $La_x Eu_{1-x}/B_6$ SOLID SOLUTIONS. Mercurio, J. P.; Etourneau, J.; Naslain, R.; Hagenmuller, P.; Goodenough, J. B. (Univ., Bordeaux). J. Solid State Chem.; 9: No. 1, 37-47(Jan 1974). (In French).

A sharp evolution from semiconducting to metallic character is observed between x = 0 and x = 0.01. Evolution with x of the atomic volume, conductivity, Seebeck coefficient, and magnetic properties are discussed in terms of a band model in which the conduction band is the 5d or 6s band of the rare-earth-atom sublattice. It is argued that chemical inhomogeneities produce a finite range of compositions over which the Seebeck coefficient changes from metallic character toward small-polaron character with decreasing x, whereas the metal-to-semiconductor transition appears more sharply defined. (10 figures, 23 references) (auth)

16148 BEHAVIOR OF VO_2 SINGLE CRYSTALS SYNTHESIZED UNDER VARIOUS OXYGEN PARTIAL PRESSURES AT 1500 K. Kimizuka, N.; Ishii, M.; Kawada, I.; Saeki, M.; Nakahira, M. (National Inst. for Researches in Inorganic Materials, Ibaraki, Japan). J. Solid State Chem.; 9: No. 1, 69-77(Jan 1974).

The effects of nonstoichiometry upon the behavior of vanadium dioxide single crystals in the vicinity of the semiconductor/metal transition temperature (T_c) were experimentally investigated. According to the electrical and thermal measurements, more stoichiometric vanadium dioxide exhibited the less electrical conductivity gap, the larger thermal and electrical hysteresis, and the lower transition temperature than the increased nonstoichiometric one near transition. Infrared absorptions and x-ray observations indicated the local and overall lattice distortion in the nonstoichiometric crystal due to the existence of V^{5+} ions. Furthermore, an intermediate phase between the low-temperature monoclinic and the high-temperature tetragonal phases was found in the nonstoichiometric VO_2. On the other hand, no evidence for this intermediate phase was found in the stoichiometric one. Finally, some comparisons and discussions of the data with previously published ones were made. (auth)

16149 STRUCTURAL CHEMISTRY OF EXTENDED DEFECTS. Eyring, L.; Tai, L. T. (Arizona State Univ., Tempe). Annu. Rev. Phys. Chem.; 24: 189-206(1973).

Studies on the characterization of extended defects are reviewed under the following section headings: structures based on crystallographic shear, including crystallographic shear and shear vectors, one-dimensional crystallographic shear (shear in molybdenum and tungsten trioxides and rutile), two-dimensional crystallographic shear, and disordered crystallographic shear; and, the fluorite-related structures, including the relationship between the fluorite and other structures (α-UO_3, CaF_2, La_2O_3, and Sm_2O_3), the fluorite-related homologous series, and disordered fluorite-related phases. (120 references) (JGB)

16150 EFFECT OF STOICHIOMETRIC COMPOSITION OF THE URANIUM-OXYGEN SYSTEM ON THE HEAT CAPACITY. Ciopec, M.; Marchidan, D. I. (Physical Chemistry Center, Bucharest). Stud. Cercet. Chim.; 21: No. 9, 993-1017(Sep 1973). (In Rumanian).

A review of the literature on phase-diagram studies of the uranium–oxygen system shows 16 well-characterized phases and 12 others whose properties are less well-defined. The oxides of most practical importance are those with the stoichiometry O/U = 2 + x, where x can vary from 0.000 to 0.666. The use of these oxides in nuclear energy work requires knowledge of the main thermodynamic properties, an important property being the heat capacity. The synthesis and principal experimental enthalpy and heat capacity data for compounds in the uranium–oxygen system and the dependence of properties on the stoichiometry are discussed. Also reviewed are theoretical studies made to evaluate the chief components of the system and their heat capacities. High-temperature data for the compounds of practical interest in nuclear technology, obtained by various authors, are presented. (28 figures, 65 references) (TTT)

16151 PROPERTIES OF CERAMIC FUELS. Thermal Conductivity, Creep, and Subjects Thereabout. Kikuchi, T. (Japan Atomic Energy Research Inst., Tokai). Zairyo Kagaku; 9: No. 3, 126-134(Jun 1972). (In Japanese).

A problem of UO_2 in use for more than ten years is thermal behavior of fuel material accompanying fission energy, and problems of UC and UN, both of which are future fuel for fast breeder reactors, are accumulation and discharge of fission products. $UO_{2\pm x}$ is only one phase over a relatively broad temperature range, while UC and UN are accompanied by a second phase, such as UC_2 or U, up to 1,000°C. Thermal conductivity of UO_2, (U, Pu)O_{2-x} solid solution, UC, UN, and UC_xN_{1-x} solid solution are reviewed. If surface temperature of the fuel T_s is 700°C in the equation $W = 4\pi\int_{T_s}^{T_c} k(T)dT$, then output of the carbide or nitride fuel amounts to twice as much as the output of an oxide fuel of $T_c \simeq 2{,}800$°C, where W is output of unit fuel, k(T) is thermal conductivity, T is internal temperature, T_s is pellet surface temperature, and T_c is center temperature of fuel. Fission-fragment damage, accumulation of fission products, rate of swelling, mechanical interaction between fuel and cladding material, and creep of ceramic fuel are reviewed. Equations for the rate of creep are reviewed and explained. Effect of creep promotion on UC or UN under radiation is recognized, but its scope is as small as one tenth of the creep of oxide. (JA)

16152 OBSERVATIONS OF COATING FAILURE AT HIGH TEMPERATURE IN COATED UC_2 PARTICLES CONTAINING UC AND FREE Si. Fukuda, K.; Kashimura, S.; Tobita, T.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci.

Technol. (Tokyo); No. 10, 640-643(Oct 1973)

Coated fuel particles with free Si in the SiC layer and UC in the UC_2 kernel were heated to 1,160 to 1,700°C for up to 200 h. Examination was made by metallography, x-ray diffraction, and electron probe. Results show that pores are formed in the coating upon heating, that the content of Si and UC decreased with temperature, and that Si diffused into the inner PyC layer and U diffused toward the coating. The coated fuel particles are liable to deterioration by heating above 1,460°C. The possible reaction of U with SiC is suggested. (DLC)

16153 ACTINIDE HYDRIDES: THE AMERICIUM–HYDROGEN SYSTEM. Roddy, J. W. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 35: No. 12, 4141-4148(Dec 1973).

Pressure-temperature-composition data and x-ray measurements were obtained to study the nature of the americium–hydrogen system using the long-lived ^{243}Am isotope($t_{\frac{1}{2}}$ = 7950 yr). A Sievert's-type apparatus was employed to perform measurements in the temperature range 125 to 880°C, in the composition range from Am to AmH_3, and at pressures from 10^{-4} to 700 torr. The existence of three homogeneous phases was established: americium solid solution, the dihydride, and the trihydride. Equilibrium plateau decomposition relationships were determined from Van't Hoff plots in the Am(ss)–AmH_2 two-phase region, yielding $\log_{10}p(torr) = -9942 \pm 38/T + 11.04 \pm 0.04$. The heat of formation of AmH_2 is $\Delta H_f = -45.5 \pm 0.2$ kcal/mole; the entropy of reaction is $\Delta S = -37.3 \pm 0.2$ cal/deg per mole. (auth)

16154 SINGLE CRYSTALS IN THE Bi_2O_3–MoO_3 BINARY SYSTEM: GROWTH AND OPTICAL PROPERTIES. Miyazawa, S.; Kawana, A.; Koizumi, H.; Iwasaki, H. (Nippon Telegraph and Telephone Public Corp., Tokyo). Mater. Res. Bull.; 9: No. 1, 41-52(Jan 1974).

Single crystals of $Bi_2O_3 \cdot 3MoO_3$ and $3Bi_2O_3 \cdot 2MoO_3$ in the Bi_2O_3–MoO_3 binary system were grown by pulling from the melt. Single-crystal $Bi_2O_3 \cdot MoO_3(Bi_2MoO_6)$, which is well known as koechlinite, could not be grown successfully. A new compound $3Bi_2O_3 \cdot 2MoO_3$ was found to melt congruently and to be easily grown from the melt. It belongs to the monoclinic-crystal system with space group C_{2h}^4. Refractive indices of $Bi_2O_3 \cdot 3MoO_3$ and $3Bi_2O_3 \cdot 2MoO_3$ were investigated. (6 figures, 4 tables) (auth)

16155 THERMODYNAMIC DATA BY SOLID-STATE EMF TECHNIQUE AND PHASE BOUNDARIES FOR SOME NONSTOICHIOMETRIC URANIUM OXIDES. Marchidan, D. I.; Matei-Tanasescu, S. (Centre of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 18: No. 10, 1681-1684(Oct 1973).

Electromotive force measurements on high-temperature galvanic cells containing solid electrolyte were carried out in order to obtain thermodynamic data for some uranium oxides which are part of the two-phase region $U_4O_9 + U_3O_{8-\gamma}$. Partial molar free energies, enthalpies, and entropies of solution of oxygen in uranium oxides and the corresponding relative integral quantities as a function of temperature, as well as the equilibrium pressures of oxygen over the oxides are calculated. (auth)

For abstracts of individual chapters see: 16302, 16303, and 16390.

16156 ANNUAL REVIEW OF MATERIALS SCIENCE. Volume 3. Huggins, R. A. (ed.). Palo Alto, CA; Annual Reviews Inc. (1973). 459p. $12.00.

Fifteen papers are included in the review. A separate abstract was prepared for each of three papers selected as in-scope for NSA. Papers for which no abstracts were prepared are concerned with materials properties phenomena, materials structure, and structural changes. (JRD)

16157 INFLUENCE OF THE TYPE OF LOADING ON HIGH-TEMPERATURE CREEPING OF ZIRCONIUM CARBIDE. Zubarev, P. V.; Dement'ev, L. N. Probl. Prochnosti; 5: 61-64(Aug 1973). (In Russian).

Bending, compression, and tensile tests were carried out with fine-grain zirconium carbide at stresses ranging from 0.2 to 2.0 kgf/mm² in the temperature range from 2150 to 2630°C. Good correlation of the creep curves is established. It is shown that the creep mechanism is not influenced by the type of loading and that creep is apparently governed by the diffusion of atoms at the grain boundaries. (IAA)

16158 VAPORIZATION AND SURFACE IONIZATION OF SCANDIUM, YTTRIUM, AND SOME RARE EARTH DICARBIDES. Sasaki, N.; Kubo, K.; Asano, M. (Kyoto Univ., Uji, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 10, 591-597(Oct 1973).

Langmuir vaporization and surface ionization of Sc, Y, and some rare earth dicarbides from a heated graphite filament were studied by mass-spectrometric means. The heats of various reactions were determined. For Lu and Y, the ratios of vaporization coefficients between those of the dicarbide molecules and those of the metal atoms were determined. Emission was observed of the thermal ions of tetracarbide molecules of La, Ce, Pr, Gd, Tb, and Y. The ratios of their intensity referred to the constituent metal ions showed a double periodicity in their variation with atomic number, similar to the case of dicarbide molecules. It can be predicted that the dissociation energies of tetracarbide molecules would vary periodically in harmony with the atomic numbers of the rare earth elements. (auth)

16159 ELECTRICAL CONDUCTIVITY OF REFIRED SINTERED URANIUM DIOXIDE PELLETS. Rao, S. V. K.; Agnihotri, P. K.; Anandan, N. S.; Prasad, G. E.; Moorthy, V. K. (BARC, Bombay). Trans. Indian Ceram. Soc.; 30: No. 3, 89-95(1971).

The electric conductivity of UO_2 pellets sintered at 1500°C and refired at 1800, 1900 and 2000°C showed a minimum at 1900°C. Conductivity is not directly related to the density or the grain size but related to the crystallinity of the material and the microstructure of the compacts. The development of microstructure during refiring was influenced by the thermal history of the samples. The measurement of conductivity appears to be a good tool for following microstructural changes. (Ind. Sci. Abstr.)

16160 SECONDARY ELECTRON EMISSION FROM INSULATORS BY ION BOMBARDMENT. Uchiike, H.; Shinoda, T.; Fukushima, Y.; Aishima, A. (Hiroshima Univ.). Shinku; 16: No. 5, 180-185(May 1973). (In Japanese).

The characteristics of secondary electron emission from a glass surface by Ar^+ ions were investigated experimentally. The yields from glass and quartz microsheets were larger than those from stainless steel. It was first observed that field-enhanced emission and self-sustained emission were caused by the surface charge. Because increasing of the yield has technological demand, HF etching and sandblast were attempted as one of the means of increasing yield. Then the yields of etched and sandblasted samples were about two times larger than that of nonetched or nonsandblasted sample. Field-enhanced emission and self-sustained emission cannot be interpreted only with kinetic ejection or potential emission theory. A simple model is proposed in which the work function decreases by the band bending with the accumulation of positive charge near the surface. (auth)

16161 HIGH-TEMPERATURE OXIDATION OF ZrC AND HfC. Voitovich, R. F.; Pugach, E. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 67-74(Nov 1973). (In Russian).

The process of high-temperature oxidation of ZrC and HfC compact samples was studied at 500 to 1200°C during 5 h in the air. Oxidation was investigated by thermodynamic, kinetic, metallographic, and radiographic layer methods and method of inert platinum taps. Interpretation of the results of the investigation is the basis for conclusions on possible mechanism of the oxidation process. (auth)

16162 INTERACTION OF BORON NITRIDE WITH TRANSITION METALS AND THEIR BORIDES AND NITRIDES. Samsonov, G. V.; Burykina, A. L.; Medvedeva, O. A.; Kosteruk, V.P. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 50-57(Nov 1973). (In Russian).

Interaction of boron nitride with titanium, zirconium, hafnium, zirconium nitride, and zirconium boride was studied using high-pressed powder mixtures within the range of temperatures 1200 to 2000°C. During interaction of boron nitride with metals the mixture of nitride and boride phases of metals is formed, the content of metal nitride being decreased with temperature elevation. Interaction of boron nitride with zirconium nitride results in formation of zirconium diboride. No interactions of boron nitride with zirconium diboride are found. (auth)

16163 IMPROVEMENTS IN OR RELATING TO PRODUCTION OF METAL OXIDES. Holland, W. P. (to United Kingdom Atomic Energy Authority). British Patent 1,334,252. 17 Oct 1973. Filed Date 31 Jun 1970. 2p.

A method is described for the production of metal oxides by thermal decomposition of their nitrates. It is considered to have particular application to the treatment of fissile materials. An aqueous solution of the nitrate is dispersed on carbon fibre felt, then heated to decompose the nitrate, and further heated in the presence of O_2 to oxidise the carbon felt. Carbon felt prepared by carbonization of cotton, wool or paper tissues has been found most satisfactory because of its low density and low impurity content. In order to effectively disperse the nitrate solution on the carbon felt a wetting agent may be required, and for nitrates of fissile metals acetic and butyric acids are satisfactory wetting agents. The oxides produced have a relatively high density.

Examples are given of application of the method, such to U and Pu. (UK)

16164 COATING MICROSPHERES WITH ZIRCONIUM CARBIDE–CARBON COMPOSITE BY THE METHYLENE DICHLORIDE PROCESS. Ikawa, K.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokai). Yogyo Kyokai Shi; 81: No. 939, 403-406 (Oct 1973).

It was demonstrated, by means of spouted-bed techniques, that the process for vapor deposition of zirconium carbide–carbon composite from the reaction products of zirconium sponge and methylene dichloride vapor was applicable to coat levitated microspheres. Carbon-to-zirconium ratio in the coating layer could be controlled by changing either hydrogen concentration in the gas supply or the length of the tube for reaction zone. Deposition below 1400°C was not practical. (auth)

16165 REFABRICATION OF HTGR FUELS. Zimmer, E.; Naefe, P.; Ringel, H. (Kernforschungsanlage, Juelich, Ger). (1973). vp. (In German).

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

The refabrication of $(Th,U)O_2$ nuclear fuel after separation of fission products in the reprocessing step of the thorium fuel cycle is described. A new wet-chemical sol-gel process is currently being tested in a pilot plant in the Nuclear Research Center Juelich. (GE)

16166 CREEP DURING HOT PRESSING OF SOME REFRACTORY COMPOUND POWDERS. Koval'chenko, M. S. (Inst. of Problems in Materials Science, Kiev). Phys. Sintering; 5: No. 2/2, 307-316(1973). (In Russian).

From third international round table meeting on sintering; Herceg Novi, Yugoslavia (3 Sep 1973).

The creep rate during hot pressing of TiB_2, TiC, TiN, Mo, Mo_2C, and $MoSi_2$ powders was measured and results tabulated. The parameters for steady-state creep are given. (JSR)

16167 STRUCTURE AND MORPHOLOGY OF BORON CARBIDE IN CONNECTION WITH THE DISLOCATION GROWTH MECHANISM AND WITH THE PRESENCE OF A NEW PHASE. Zberea, I.; Teodorescu, V. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 7, 947-948(1973).

$B_{12}C_3$ whiskers and plates were examined by optical and electron microscopy and electron diffraction after sputtering and recrystallization. The carbide crystallized in brittle plates contains the rhombohedral phase and also the hexagonal phase whose c parameter lies between 11.9 and 12.12 Å. The hexagonal phase is associated with the presence of thin graphite platelets. The {001} planes of the graphite are superposed and parallel with the {120} planes of the boron carbide. (DLC)

16168 INFLUENCE OF METAL POWDERS CONTAINING REFRACTORY COMPOUNDS PRODUCTION METHODS ON ITS SINTERING. Roman, O. V.; Dubrovskaya, G. N.; Dvoreckaya, M. A.; Korotkina, M. N. (Belorussian Polytechnic Inst., Minsk). Phys. Sintering; 5: No. 2/2, 405-414(1973). (In Russian).

From third international round table meeting on sintering; Herceg Novi, Yugoslavia (3 Sep 1973).

In materials obtained by chemical methods with sintering, the optimum conditions for boundary diffusion and activation of sintering processes are created as these materials are shaped in the form of microcrystalline structure with increased activity of the particles because of the close contact of the heterogeneous particles during the production. Materials obtained by chemical methods are preferable for construction as they are very stable at increased temperature. Materials studied include $Fe-Al_2O_3$, $Ni-Al_2O_3$, $Ni-ZrO_2$, and Fe–NbC. (tr-auth)

16169 FABRICATION OF FUEL ELEMENTS. Stoll, W. (Alpha Chemie und Metallurgie, GmbH, Hanau, Ger.). (1973). vp. (In German).

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

A survey is given on the production of fuels. The production of oxide fuels for water reactors are dealt with more closely and the following aspects are described: methods for the recovery of UO_2, sintering and compacting processes, the processing of pellets, and requirements for fuel cladding tubes and fuel rods. Aspects of production of block elements as well as spherical particle concept are considered. Special points of the fast breeder fuel element production are briefly examined. (GE)

16170 CONDITIONS FOR OBTAINING TECHNICAL ZrB_2 BY CARBONTHERMAL REDUCTION OF MIXTURES OF Zr AND B OXIDES. Karasev, A. I. (Kiev Polytechnic Inst.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 80-84(Nov 1973). (In Russian).

The dependence of ZrB_2 chemical composition obtained by carbonthermal method, on temperature and holding period, rate of temperature rise to optimum, charge composition, and gaseous medium composition in the furnace was investigated. It was found that the temperature 2000°C with 20 to 30% excess of B_2O_3 in the charge is optimal for obtaining ZrB_2 powder of technical purity. Rate of the temperature rise to optimum with holding period above 60 min has no practical influence on the chemical composition of the product. The holding period depends on the loading weight and volume of the reactive space of the furnace. The converted gas may be used instead of hydrogen when obtaining ZrB_2. (auth)

16171 COMPACTION KINETICS DURING HOT PRESSING AND RECRYSTALLIZATION OF CARBIDES. Spivak, I. I.; Klimenko, V. V. Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 24-30(Nov 1973). (In Russian).

Kinetics of compaction by hot pressing and recrystallization of vanadium, titanium, and zirconium carbides is investigated. Diffusion effects connected with the grain boundaries are shown to have an essential influence on the set of process, accompanying the compaction and recrystallization. (auth)

16172 CONTINUOUS SERIES OF CARBIDE SOLID SOLUTIONS WITH NaCl-TYPE STRUCTURE IN THE TERNARY SYSTEMS $Mo(W)-Me_{IV-V-C}$. Eremenko, V. N.; Velikanova, T. Ya.; Shabanova, S. V.; Artyukh, L. V. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 58-62(Nov 1973). (In Russian).

On the basis of the literature data it is assumed that in all systems the continuous mutual solubility of carbides with the NaCl type structure is found. This assumption is confirmed by the experimental investigation of the alloys hardened from subsolidus temperatures in the ternary systems with Ti, Zr, Hf, and V, the data on the structure of which (at high temperatures) are not presented in the literature. (auth)

16173 DENSIFICATION BEHAVIOR AND PHASE CHANGES IN TiO_2-ZrO_2 AND $TiO_2-Al_2O_3$ COMPOSITES FIRED UNDER OXIDIZING AND REDUCING ATMOSPHERES. Samdani, S. G.; Chary, M. N.; Ali, A. (Osmania University Coll., Hyderabad, India). Trans. Indian Ceram. Soc.; 29: No. 4, 109-112(Jul 1970).

X-ray diffraction studies and densification measurements were carried out on three compositions, 75% TiO_2 + 25% ZrO_2, 75% TiO_2 + 25% Al_2O_3, and 100% TiO_2, designated as TZ, TA and T respectively, heated under oxidizing and reducing atmospheres between 1200 and 1400°C. The densification was always higher and the formation of the new phases took place with greater ease when the specimens were fired under reducing conditions. This was possible due to the formation of anionic vacancies in the TiO_2 structure, which would enhance diffusion. (auth)

16174 FORMATION CONDITIONS OF La, Nd, AND Y ORTHOVANADATES AND PHASE RELATIONS IN $Nd_2O_3-V_2O_5$. Isupova, E. N.; Godina, N. A.; Keler, E. K. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1076-1080(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1214-1218(Jul 1973).

The kinetics of formation of lanthanum, neodymium, and yttrium orthovanadates from various different initial components were investigated showing that orthovanadate formation is intense at temperatures of up to 450 to 600°C. The activation energies of orthovanadate formation were calculated as formed from oxides, from oxalates, and hydroxides of lanthanum, neodymium, and yttrium and from ammonium metavanadate under isothermal and nonisothermal conditions. The reactions of oxides in the system $Nd_2O_3-V_2O_5$ were studied, and the formation of two compounds—$NdVO_4$ and Nd_5VO_{10} were established. (auth)

16175 LANTHANUM, CERIUM, PRASEODYMIUM, AND NEODYMIUM TITANONIOBATES. Sych, A. M.; Klenus, V. G. (Kiev State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1081-1084(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1219-1222.

The preparation and properties of rare earth titaniobates were investigated. It was found that rare earth titanoniobates with the composition $LnTiNbO_6$ (Ln is La, Ce, Pr, or Nd) can be obtained by roasting coprecipitated metal hydroxides; the synthesis temperature is 850 to 900°C. The reaction between rare earth, titanium, and niobium hydroxides takes place at relatively low temperatures and begins during precipitation of the hydroxides. Rare earth titanoniobates of the cerium subgroup crystallize in the eschynite type. (auth)

16176 STRUCTURE OF BOROSILICATES, STUDIED BY MEANS OF RADIO AND MOESSBAUER SPECTRA WITH THERMAL SHOCK. Tsyganov, A. D.; Ovchinnikov, A. I.; Shevelevich, R. S.; Kalinin, P. S. (Physical-Technical Inst. of Low Temperatures,

Kharkov). Inorg. Mater. (USSR) Engl. Transl.); 9: No. 7, 1085-1088(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1223-1226.

Results of the studies show that, in alkali potassium borosilicates, thermal shock apparently causes phase separation; the field symmetry increases, and boron passes from threefold to fourfold coordination, the latter being due to increase of the ionicity of the chemical bonds Sn(Si)-O. In glass fibers, one type of chemical bond arises preferentially for each component of the glass-forming system. (auth)

16177 DEMIXING IN SYSTEM TITANIUM-NIOBIUM-OXYGEN. Dekanenko, V. M.; Vavilova, V. V.; Kornilov, I. I. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1126-1127(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1266-1267(Jul 1973).

To determine the demixing limits, the cross sections NbO-TiO, NbO-Ti_2O, Nb-Ti_2O and Ti-NbO, and the cross sections containing 5, 10, 15, 20, 30, and 40 at. % Ti were investigated. It was found that Nb-Ti_2O is a quasi-binary cross section and the demixing region is enclosed within the concentration triangle Nb-Ti_2O-O. The simultaneous presence of titanium and oxygen in niobium leads to layer separation. During layer separation, titanium, which has a high affinity for oxygen actively reacts with it to form low-density oxides, which become detached from the heavier niobium-based alloy. At high contents titanium combines practically all the oxygen. During this process niobium is refined. If the titanium content is insufficient, complex oxides containing niobium as well are formed. The high affinity of titanium for oxygen, and the low density of the titanium oxides formed, are apparently the cause of layer separation in the system titanium-niobium-oxygen. (auth)

16178 REACTION OF NICKELOUS OXIDE WITH HAFNIUM DIOXIDE. Timofeeva, N. I.; Timofeeva, E. N.; Romanovich, I. V. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1128-1129(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1268-1269(1973).

The phase composition of specimens of the system NiO-HfO_2 in a wide range of concentrations and temperatures was studied. The starting materials were nickel and hafnium nitrate $Hf(NO_3)_2 \cdot 2H_2O$. To prepare the initial compositions, metallic nickel was dissolved in concentrated nitric acid, and hafnium nitrate was dissolved in dilute nitric acid (pH 2). The solutions were filtered, mixed, and evaporated to dryness; the dry salts were then roasted at 400 to 800°C for 2 h to remove oxides of nitrogen. The mixtures thus obtained were subjected to heat treatment for 25 h at 400, 600, 800, 1000, and 1200°C in air. It was established that hafnium dioxide obtained by decomposition of hafnyl nitrate has different chemical stabilities, depending on the roasting temperature; the solubility of HfO_2 obtained by roasting at 400°C for 25 h is 30%, the corresponding values for 600 and 1000°C being 14% and 0.2%. The NiO obtained under these conditions dissolves in hydrochloric acid in 1.5 to 2 h. The experimental data are the basis for inference that hafnium oxide does not react with nickelous oxide at 400 to 1200°C, and in fused compositions such a reaction is absent throughout the range of concentrations. (auth)

16179 INVESTIGATION OF LaB_6 SUBJECTED TO HIGH-TEMPERATURE COMPACTING AT HIGH PRESSURES. Zhuravlev, P. N.; Manelis, R. M.; Belousova, I. A.; Nurmukhamedov, V. Kh. (Moscow State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1033-1035(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1162-1165(Jul 1973).

Specimens of LaB_6 compacted at high pressures and temperatures were examined. It was found that when lanthanum hexaboride powders are compacted at high temperatures and pressures, sintering is accompanied by decomposition to lanthanum boride corresponding approximately to the formula LaB_6, and free boron. This process is also accompanied by evolution of free lanthanum vapor, which is removed from the sintering zone. The LaB_6 formed retains the CaB_6 structure, but the unit-cell volume increases by more than 1% in comparison with the initial hexaboride. The lanthanum hexaboride lattice is retained in a wide range of compositions owing to formation of a defect structure with a deficiency of lanthanum atoms in the CaB_6-type lattice. Formation of a defect structure is accompanied by a change in the density and color of the boride crystals without any change in the unit-cell size. When there is a marked deficiency of lanthanum atoms (in the range LaB_6 to LaB_5), the unit-cell size increases. (auth)

16180 PLASTIC PROPERTIES OF ZrC and NbC IN THEIR REGIONS OF HOMOGENEITY. Avgustinik, A. I.; Ordan'yan, S. S.; Fishchev, V. P. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1039-1041(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1169-1171(Jul 1973).

Homogeneous mono carbide phases of Zr and Nb were investigated. It was found that the concentration dependences of the moduli of elasticity of Zr and Nb carbides have different characteristics owing to the difference between the energy spectra of the valence electrons of carbides of transition metals of groups IV and V. (auth)

16181 PLASTIC DEFORMATION OF Ni AND ZrC POWDERS DURING PROLONGED VIBROGRINDING. Kravchik, A. E.; Neshpor, V. S. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1042-1044(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1172-1175(Jul 1973).

The deformation patterns of Ni and ZrC powders were studied. It was found that deformation of nickel powders during vibrogrinding takes place by the generally accepted scheme: the grains are crushed in blocks, lattice deformations arise, and the concentration of packing defects and twins increases. In the case of zirconium carbide the crystalline phase is rendered partly amorphous, i.e., the deformation mechanism is similar to the plastic deformation mechanism of quartz. Formation of the amorphous phase is due to the directed covalent bonds in zirconium carbide, which greatly increase the level of the Peierls-Nabarro barriers, which prevent movement of dislocations. (auth)

16182 RECRYSTALLIZATION OF VANADIUM OXYCARBIDES. Samsonov, G. V.; Bilyk, I. I.; Bozhko, S. A. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1045-1047(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1176-1179(Jul 1973).

The kinetics of recrystallization of vanadium oxycarbides were studied. It was found that increase in the carbon content of vanadium oxycarbides (within the region of homogeneity of vanadium carbide) reduces grain growth during sintering only slightly, but increase of the oxygen content from 0.2 to 2.5 wt % markedly reduces grain growth owing to stabilization of the lattice and increase in the concentration of localized electrons. (auth)

16183 THERMAL STABILITY OF COMPLEX NITRIDES OF ELEMENTS OF SUBGROUP IIIB. Lyutaya, M. D.; Bartnitskaya, T. S. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1052-1054(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1186-1188(Jul 1973).

The thermal stability of complex nitrides of elements of subgroup IIIB in nitrogen, ammonia, and air was investigated. It was found that in nonoxidizing media the thermal stability of complex nitrides is higher than that of simple nitrides and is governed by the stability of the nitride, the crystal structure of which is retained during formation of the complex nitride. In air, complex nitrides are oxidized to higher oxides and nitrogen. Oxidation of complex nitrides takes place via formation of intermediate oxy compounds, the structure of which depends on the oxygen and nitrogen concentrations. (auth)

16184 OXIDATION IN THE SYSTEM U-Ce-O. Landspersky, H. (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 19: No. 8, 272-273(1973). (In Czech).

The U-Ce-O system was studied as a stand in for the U-Pu-O system with regard to formation of solid solutions, oxidation at high temperatures, and stoichiometric ratios. Results obtained agreed with literature data. The product containing 20% CeO had the formula $(U_{0.72}Ce_{0.28})O_{2.29\pm0.02}$ and structural analysis showed the presence of U_3O_8 plus a cubic phase with a = 5.421 ± 0.003 Å. For pure UO_2 and UO_2 with 5% CeO, the activation energy was 32 ± 3 kcal/mole at 340 to 510°C. Kinetic equations are presented. (tr-auth)

16185 THERMODYNAMIC PROPERTIES OF Ni_3B AND Ni_2B BY EMF MEASUREMENTS. Omori, S.; Hashimoto, Y. (Himeji Inst. of Tech., Japan). Funtai Oyobi Funmatsuyakin; 20: No. 3, 80-86(Jul 1973). (In Japanese).

Standard free energies of formation of Ni_3B ($\Delta G°_{Ni_3B}$) and Ni_2B ($\Delta G°_{Ni_2B}$) were determined by emf measurements of the cells; $\langle P_t \rangle$ O_2 in air $|ZrO_2 \cdot CaO|$ Ni-22 at %B alloy powder, B_2O_3 $\langle P_t \rangle$ (for Ni_3B), and $\langle P_t \rangle$ O_2 in air $|ZrO_2 \cdot CaO|$ Ni-32 at % B alloy powder, B_2O_3 $\langle P_t \rangle$ (for Ni_2B). Standard enthalpies and entropies of formation of Ni_3B and Ni_2B were calculated by applying Gibbs-Helmholtz's equations to these $\Delta G°_{Ni_3B}$ and $\Delta G°_{Ni_2B}$ values, respectively. The results obtained are as follows: $\Delta G°_{Ni_3B} = -31{,}720 + 10.56\ T \pm 200$ cal/mol, $\Delta H°_{Ni_3B} = -31{,}720$ cal/mol, and $\Delta S°_{Ni_3B} = -10.56$ cal/mol, °K at 975 to 1225°K, also $\Delta G°_{Ni_2B} = -25{,}604 + 7.24$

T ± 200 cal/mol, $\Delta H°_{N_4B}$ = −25,604 cal/mol, and $\Delta S°_{N_4B}$ = −7.24 cal/mol, °K at 1050 to 1200°K. (auth)

16186 CHANGES IN SURFACE RELIEF OF NONIRRADIATED AND IRRADIATED BeO ON ANNEALING. Khudyakov, A. V. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1058-1060(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1192-1194(Jul 1973).

Specimens of nonirradiated BeO and BeO irradiated with fast neutrons were studied by electron microscopy. The structures of the nonirradiated BeO remains unchanged after annealing at 1400°C. In beryllium oxide irradiated at 100°C, marked acceleration of surface relief changes during annealing at 1400°C were found both at the surfaces of large pores within the crystal and on the crystal's free surface. The probable cause of this phenomenon is the emergence of helium–vacancy complexes at the surface after thermal disruption of these complexes. (JRD)

16187 METHOD OF FABRICATING POROUS METAL BODIES. Strazza, N. P. (to Isotopes, Inc.). US Patent 3,652,745. 28 Mar 1972. Filed date 30 Jul 1969. 8p.

In the fabrication of porous metal bodies, and in particular, control bodies for nuclear reactors with or without integral fuel material, by powder metallurgical techniques, the utilization of a metal hydride binder imparts green strength to the body formed prior to sintering and results in a sintered body with smooth, strong bonds connecting the powder particles and with clean, uncontaminated interior surfaces. (Official Gazette)

16188 IN SITU GROWTH OF ALIGNED COMPOSITES FROM THE VITREOUS STATE: THE $Li_2O-B_2O_3$ SYSTEM. Carpay, F. M. A.; Cense, W. A. (Philips Research Lab., Eindhoven, Netherlands). Scr. Met.; 8: No. 1, 11-14(Jan 1974).

Growth kinetics in the system $Li_2O-B_2O_3$ prepared from the vitreous state in a reversed temperature gradient were investigated. It was found that a number of systems are appropriate to aligned in-situ composite growth. Features of the system show that volume fractions can be widely varied while preserving regularity. Systems without a eutectic composition can also be used. (JRD)

16189 FORMATION OF DIFFUSION COATINGS ON NICKEL CONTAINING DISPERSED THORIA. Baldi, A. L. (to Alloy Surfaces Co., Inc.). US Patent 3,764,371. 9 Oct 1973. Filed date 18 Nov 1970. 10p.

Rich chromium diffusion coating on TD nickel or TD Nichrome is obtained in one step by embedding work in chromium diffusion coating pack containing nickel with or without cobalt, and held in an unsealed retort cup at least 15 inches high. Magnesium halide is helpful to have in the pack and pack can also contain metallic iron to reduce coating temperature. Masking is arranged by covering the sites to be masked with a layer of a mixture of nickel powder and inert filler. For better high-temperature oxidation resistance the chromium-rich coating is covered by an aluminum diffusion coating from a simple aluminum diffusion pack or one that has the aluminum mixed with chromium. Low temperature aluminum diffusion is more uniform when pack energizer is aluminum chloride or other material that does not generate nitrogen. A manganese-containing aluminizing pack gives better protection than a simple aluminizing pack, particularly against marine corrosion, and when there is a conversion coating applied over the aluminizing. Conversion coating mixture wets aluminized ferrous surface better when the surface has been treated with alkali to blacken it, and the black is then removed with the help of nitric acid. Aluminized superalloy can be heated in air to whiten it, then cleaned to give product having more adherent case. Also adding some lanthanum or yttrium to superalloy like WI 52 gives better high-temperature resistance. (Official Gazette)

16190 PREPARATION AND INVESTIGATION OF LaB_6 FILMS. Winsztal, S.; Majewska-Minor, H.; Wisniewska, M.; Niemyski, T. (Research Center for Crystals, Warsaw). Mater. Res. Bull.; 8: No. 12, 1329-1336(Dec 1973).

The processes of crystallization and the properties of LaB_6 films obtained on insulating substrates by means of cathode sputtering were investigated. The films were obtained on amorphous and single crystal substrates at temperatures ranging from 100 to 1250°C. Structure and the electrical and optical properties of the prepared films were investigated. Polycrystalline textured layers were obtained with carrier concentrations similar to those of the bulk material and resistances several times higher than those of the bulk molten material. (auth)

16191 GROWTH AND CHARACTERIZATION OF PURE AND RARE-EARTH-SUBSTITUTED YVO_4. Chow, K.; McKnight, H. G. (Union Carbide Corp., San Diego, CA). Mater. Res. Bull.; 8: No. 12, 1343-1350(Dec 1973).

The problems associated with the Czochralski growth of YVO_4 including melt composition, inclusions, color center formation, thermal gradient, cleavage, growth axis, and dislocations are discussed. The characterization of alphabet YVO_4 is also presented. (auth)

Metals and Alloys

Refer also to abstracts 16061, 16125, 16127, 16156, and 18011.

16192 STRUKTURA I SVOISTVA MONOKRISTALLOV TUGOPLAVKIKH METALLOV. (Structure and Properties of Refractory-Metal Monocrystals). Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). 260p.

A separate abstract was prepared for each of 28 papers on properties and structure of refractory metal monocrystals. (JRD)

Corrosion and Erosion

Refer also to abstract 17424.

16193 (AERE-R-7607) COMPATIBILITY OF TYPE 316 STAINLESS STEEL AND NITROGEN IN THE PRESENCE OF SODIUM. Yates, A.; Paris, R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Type 316 stainless steel capsules containing sodium and a pure nitrogen cover gas were heat treated for five weeks at 250, 500, 600, and 700°C to discover if the presence of sodium led to any unacceptable nitridation of the clad. Effects observed which could be attributed to nitrogen enhanced by sodium vapor were small. It is concluded that traces of nitrogen in the plena of sodium-bonded fuel pins would have no deleterious effect. (auth)

16194 (N-73-24660) COMPATIBILITY TESTS OF MATERIALS FOR A LITHIUM-COOLED SPACE POWER REACTOR CONCEPT. Sinclair, J. H. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). May 1973. 28p. (NASA-TN-D-7259). NTIS.

Materials for a lithium-cooled space power reactor concept must be chemically compatible for up to 50,000 h at high temperature. Capsule tests at 1040°C were made of material combinations of prime interest: T-111 in direct contact with uranium mononitride (UN). Un in vacuum separated from T-111 by tungsten wire, UN with various oxygen impurity levels enclosed in tungsten wire lithium-filled T-111 capsules, and TZM and lithium together in T-111 capsules. All combinations were compatible for over 2800 h except for T-111 in direct contact with UN. (STAR)

16195 (NIIAR-P-178) APPLICATION OF THE EXOELECTRON EMISSION METHOD TO THE STUDY OF ZIRCONIUM AND ZIRCONIUM-ALLOY OXIDATION. Votinov, S. N.; Kortov, V. S.; Raetskii, V. M.; Belokopytov, V. S.; Kravtsova, L. S.; Gaprindashvili, A. I.; Myasnikov, I. E. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Melekess (USSR)). 1972. 23p. (In Russian). INIS.

The results of an investigation of the possibility of using exoelectron emission to study the oxidation of Zr and its alloy with 1% Nb were reported. The measurements were made in a high-vacuum installation using the secondary electron multiplier of the open type as a detector of the low-energy exoelectrons. From the test results a correlation was established between the kinetics of the Zr oxidation and the change of parameters characterizing exoemission. A connection was established between the characteristics of the emission and the alloying and the medium in which the oxidation was produced. The results of the preliminary investigation showed that the exoemission has structure-sensitive characteristics of the surface of the oxidized material relating to the course of the electron processes at the surface. It was assumed that the study of the oxidation processes of Zr and its alloy can offer predictions on the corrosion stability of reactor materials and the possibility of the selection of the optimum technological regimes of their processing. (tr-auth)

16196 OXIDATION OF Nb–Mo ALLOYS OVER THE TEMPERATURE RANGE OF 485 TO 935°C. Yamawaki, M.; Kanno, M.; Mukaibo, T. (Tokyo Univ.). Denki Kagaku; 41: No. 10, 753-758(Oct 1973).

The oxidation behavior of Nb–2.5, 5.0, and 7.5 at.% Mo alloys was investigated in detail by means of thermogravimetric measurement, x-ray diffraction, and metallographic methods. The tests were conducted at temperatures ranging from 485 to 935°C in dry oxygen at a pressure of 0.20 atm. Generally the para-linear

or pseudo para-linear type of oxidation curve was obtained. The apparent linear oxidation rate of the alloys was calculated from the post transition part of each oxidation curve and was found to be generally lower than that of pure niobium. Breakaway of a thin protective layer formed at low temperatures was delayed by molybdenum alloying. At temperatures ranging from 635 to 735°C on Nb–5.0 or 7.5 at.% Mo alloy, a thin protective layer of NbO_2 was formed to give a high oxidation resistance, under which NbO_2 platelets were formed abundantly. The B–Nb_2O_5 was for the first time identified in the scales on the Nb–Mo alloys at temperatures ranging from 685 to 835°C. Oxidation of Nb–2.5 at.% Mo alloy at 835°C was found to show a peculiar parabolic to plateau-like type rate transition and this was attributed to the T to B structural transition of Nb_2O_5 in scale. (auth)

16197 SULFIDATION PROPERTIES OF Ni–20 wt. % Mo ALLOY IN H_2–H_2S ATMOSPHERES AT 700°C. Young, D. J.; Smeltzer, W. W.; Kirkaldy, J. S. (McMaster Univ., Hamilton, Ont.). Oxidation Metals; 7: No. 3, 149-161(Dec 1973).

The sulfidation kinetics and morphological development of reaction products for a Ni–20 wt. % Mo alloy exposed at 700°C to H_2–H_2S atm at sulfur pressures in the range 1×10^{-11} to 2×10^{-2} atm at sulfur pressures in the range 1×10^{-11} to 2×10^{-2} atm are reported. At $p_{s_2} \leq 5 \times 10^{-11}$ atm, the reaction product was Mo_2S_3 which grew as an external scale by parabolic kinetics. For $1 \times 10^{-10} < p_{s_2} \leq 4 \times 10^{-10}$ atm, simultaneous internal precipitation and external growth of MoS_2 occurred by linear kinetics. An external duplex scale was formed at sulfur pressures $2 \times 10^{-9} < p_{s_2} \leq 2 \times 10^{-2}$ atm in which the inner layer was a two-phase mixture of MoS_2 and nickel sulfide, and the outer layer contained solid nickel sulfides and a liquid Ni–Mo sulfide phase. Catastrophic linear kinetics occurred under these latter conditions. (8 figures, 18 references) (auth)

16198 CONVERSION-ELECTRON LINE-SHAPE ANALYSIS AND APPLICATIONS TO MÖESSBAUER SPECTROSCOPY. Miller, R. B. Columbus, OH; Ohio State Univ. (1973). 272p. University Microfilms Order No. 73-26, 872.

Thesis (Ph. D.).

A nondestructive method which utilizes the technique of both Möessbauer spectroscopy and β spectroscopy to obtain spatial information concerning the various chemical phases on the surface of a specimen is proposed and analyzed. The method, descriptively referred to as spatially resolved Möessbauer spectroscopy, would provide a means for determining pre-parabolic oxidation rate constants, alloy inter-diffusion coefficients, oxygen solubilities and diffusivities in metals and alloys, and transport properties in doped alloy oxides. The technique relies on the Doppler shift of a constant velocity Möessbauer source to provide selection of the chemical phase. Nuclei in the selected chemical phase are resonantly excited by Möessbauer photons and decay by emitting monoenergetic conversion electrons. Depth information is provided by analyzing the conversion electron spectrum emerging from the surface of the specimen. The fundamental equation to be solved is a Fredholm integral equation of the first kind relating the conversion electron spectrum to the depth distribution of the conversion electra source (the selected chemical phase) by means of an electron transport kernel. The shape of the kernel largely determines the ease with which source distributions can be unfolded from conversion electron spectra, and much effort is devoted to characterizing this response function. An age diffusion calculation is shown to be inadequate because of the continuous energy loss assumption. More satisfactory techniques are then developed, including unfolding from experimental data (computer code DACES1), and a Monte Carlo simulation (computer code ELTRAS). To assess the feasibility of unfolding source distributions from conversion electron spectra, the unfold code DACES2 is developed and used to unfold unknown ^{125}Xe (E_0 = 21.79 keV) source distributions in Ta_2O_5 from conversion electron spectra generated by the DACES1 kernal, and ^{57}Fe (E_0 = 7.3 keV) source distribution in metallic iron from conversion electron spectra generated by the ELTRAS kernel. The results of these numerical experiments indicate that spatially resolved Möessbauer spectroscopy is entirely feasible for iron and iron-bearing compounds for source depths $\lesssim$ 500 A, but would be less feasible for tin compounds because of the more energetic ^{119}Sn conversion electron (E_0 = 19.6 keV). (Diss. Abstr. Int., B)

16199 STRESS CORROSION CRACKING OF A LOW-ALLOY STEEL IN ACETATE SOLUTIONS. Parker, J. G.; Pearce, W. G. (Central Electricity Generating Board, Bristol, Eng.). Corrosion; 30: No. 1, 18-23(Jan 1974).

Various stress corrosion tests were carried out on a 3CrMo steel in ammonium acetate solution. Intergranular cracking occurred at both the molar and 0.1 molar levels. Other acetates show characteristics favoring stress corrosion. It was found that phosphate additions inhibit both crack initiation and propagation in constant strain tests. The susceptibility to cracking and the form of cracking were found to be dependent upon the type of test used. Results suggest that the control of pH and potential is essential for testing in aggressive solutions. (9 figures) (auth)

16200 INTERACTION OF LASER RADIATION WITH A W SURFACE. Kuznetsov, V. A.; Shchuka, A. A. pp 86-92 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

An autoelectron microscope was used to study the desorption of residual gases from the surface of a monocrystal edge under the influence of laser radiation. It was shown that an irradiation regime could be selected in which there would be no surface destruction. A laser probe was used to study the desorption of gases from the surface of a large tungsten sample. (tr-auth)

16201 EFFECT OF CRYSTALLOGRAPHIC ORIENTATION AND SUBSTRUCTURE ON KINETIC OXIDATION OF MONOCRYSTALS OF REFRACTORY METALS. Larikov, L. N.; Tyshkevich, V. M. pp 92-98 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The effects of crystallographic orientation and substructure on the mechanism and kinetics of oxidation of monocrystals of molybdenum and tungsten when heated in air were studied. It was found that different crystallographic planes differ in oxidation behavior. The oxidation rate also differed for molybdenum monocrystals with different degrees of plastic deformation. (tr-auth)

16202 CORROSION RESISTANCE OF A Mo MONOCRYSTAL IN AN INERT GAS CONTAINING O_2, N_2, AND ACETYLENE. Dushin, Yu. A.; Emel'yanova, L. I.; Solomko, Yu. V. pp 104-113 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The structure and properties of molybdenum monocrystals were studied after being exposed at 1500°C in a current of argon with separate additions of oxygen, nitrogen, and acetylene. The results of the experiments agreed with gas-dynamic and dislocation predictions concerning corrosion stability of the metal. By removing the sample and decreasing the concentration of the additive, it was possible to hinder the formation of a substructure and avoid embrittlement of the monocrystal during use. (tr-auth)

16203 HIGH-TEMPERATURE TESTING OF REFRACTORY METALS IN A CONTROLLED CURRENT OF INERT GAS. Dushin, Yu. A.; Emel'yanov, L. I.; Borisov, A. Ya.; Konin, M. K.; Zemlyankin, V. A. pp 113-119 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The stand used for prolonged (up to 100 h) high-temperature (up to 1700°C) testing of metals in an argon stream with a velocity of 230 m/sec is described. A continuously acting analytical train permits simultaneous automatic recording of a stream of basic mixture of argon with O_2, N_2, H_2O, and C_nH_m at intervals of from 10 to 10^{-4} vol %. Oxidation and carbonization experiments showed a high corrosion resistance of molybdenum monocrystals, and its use in construction of an inert gas heater is discussed. (tr-auth)

16204 EFFECT OF INERT MEDIUM ON MECHANISM OF W DESTRUCTION IN LIFETIME TESTS. Manaeva, E. N.; Mordyuk, V. S.; Sinitsyn, G. F.; Cherkashin, V. I. pp 192-197 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The results of studies on the effects of an inert medium on the heat-resistance properties of tungsten wire used in the lighting engineering industry are presented. A significant decrease in the long-term stability of the metal in an inert gas (argon) medium was observed compared with that in a vacuum, reaching values of two orders of magnitude. (tr-auth)

16205 ANISOTROPY CHARACTERISTICS IN MOTION OF MEDIUM-ENERGY ELECTRONS IN W MONOCRYSTALS. Gomoyunova, M. V.; Aliev, B. Z. pp 198-207 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Effects of anisotropy characteristics on motion of medium-energy electrons in a periodic field of a tungsten lattice were studied. The coefficient of secondary electron emission (SEE) was studied. The dependence of the recoil coefficients of the SEE electrons and the actual SEE dependence on the angle of impingement of the electrons on the tungsten {111} face were determined. Diffraction of electrons on different systems of planes in bcc crystals is considered. (tr-auth)

16206 OXIDATION OF HEAT-RESISTANT NICKEL ALLOYS CONTAINING MOLYBDENUM. Lashko, N. F.; Glezer, G. M. Prot. Metals (USSR) (Engl. Transl.); 8: No. 6, 592-596(1972).

Translated from Zashch. Metal.; 8: No. 6, 654-659(1972).

The presence of liquid phase in the scale on heat-resistant alloys is one of the possible reasons for the intense oxidation. The reason for the intensified oxidation of molybdenum-containing nickel alloys is molybdenum, which leads to the formation of a porous layer beneath the scale. This layer contains $NiMoO_4$ and leads to loss of the protective qualities of the scale. Replacement of molybdenum by an equivalent amount of tungsten retards the intense oxidation process. Alloying of molybdenum-containing nickel alloys with iron prevents the formation of a porous sublayer containing $NiMoO_4$. (auth)

16207 PROTECTION OF HIGH TEMPERATURE METALLIC MATERIALS AGAINST OXIDATION. II. Protective Layers on Superalloys and High-Temperature Materials. Lux, B. (Battelle Memorial Inst., Geneva). Z. Werkstofftech.; 4: No. 8, 427-433 (Dec 1973). (In German).

The structures of typical protective coatings of superalloys and Nb alloys are briefly described and possible reasons for their failure are given. The importance of self-healing properties and of the reliability of such protective layers in any technical application is stressed. The order of magnitude of the duration of protection for different alloys is indicated for several coating types. (GE)

16208 NATURE OF ANODIC DISSOLUTION OF Cu–Zn, Ag–Zn, AND Ag–Cd ALLOYS. Marshakov, I. K.; Bolychev, V. S.; Potapova, O. P. (Voronezh State Univ., USSR). Zashch. Metal.; 9: No. 1, 3-9(Jan 1973). (In Russian).

By the rotating disc ring electrode method the dissolution mechanism of alloys of the Cu–Zn, Ag–Zn, and Ag–Cd system in 0.5 N NaCl, 0.1 N H_2SO_4, 0.1 N HCl, and 0.1 N KNO_3 was studied. The results obtained were compared with the anode behavior of the system. These systems give a series of solid solutions sufficiently similar to each other and thus make it possible to trace the effects of the nature of the primary and secondary components. The satisfactory correlation between the conclusions on the dissolution mechanisms for the solid solutions on the basis of their electrochemical behavior and the results of the study on the rotating-disc ring electrode was shown. (tr-auth)

16209 OXYGEN FORMATION ON SURFACES OF LEAD, INDIUM, AND THEIR ALLOYS. Borshchevskii, A. M.; Baturova, L. P.; Skorchelletti, V. V. (Leningrad Polytechnical Inst.). Zashch. Metal.; 9: No. 3, 257-263(May 1973). (In Russian).

A series of cathode curves of the charge removed after ten-second polarization at different potentials were used for the identification of different oxygen compounds arising on the surface of Pb, In, and their alloys during anode polarization in dilute alkalies. The mechanism of the formation of these compounds, their role in the passivation process taking the alloy composition into account, and the slight diffusion of its compounds into the metallic phase was discussed. (tr-auth)

16210 INVESTIGATION INTO ZIRCONIUM OXIDATION (IN THE GAS PHASE) IN THE RANGE 1000 TO 1400°C BY ELECTROCHEMICAL PARAMETERS. Opara, B. K.; Vtulkin, A. V.; Pokin, M. N.; Kravetskii, G. A.; Rakoch, A. G. Zashch. Metal.; 9: No. 2, 131-136(Mar 1973). (In Russian).

The applicability of the electrochemical model and measurements to the study of the oxidation mechanism of Zr in the temperature range from 1000 to 1400°C was shown. The extreme dependence of the electromotive force on the temperature, connected with the structural conversion of the ZrO_2, was discussed. It was shown that in the area of structural conversion the maximum value of the ion conductivity fraction of the ZrO_2 is 0.5 and is reduced to 0.3 during extended temperature increase up to 1400°C because of the increase of the electron conductivity. The proportionality of the oxidation rate to the current through the oxide film during its growth was established. The polarity of the galvanic cell $Zr|ZrO_2|Pt,O_2$ can be changed as a function of the partial pressure of the oxygen in the gas phase. During heating in an atmosphere with low partial pressure of oxygen (argon atmosphere) liberation of the oxygen from the oxide film on the Zr occurs. (tr-auth)

16211 PROBLEMS IN LIQUID SODIUM CORROSION. Furukawa, K. (Japan Atomic Energy Research Inst., Tokai). Zairyo Kagaku; 9: No. 3, 141-149(Jun 1972). (In Japanese).

Fundamental studies on the corrosion of metal, particularly stainless steel, by liquid sodium are reviewed. Temperature-gradient mass-transfer phenomena are stressed. The phenomena are influenced by local temperature, temperature difference, temperature distribution over whole loop, flow speed, concentration of nonmetallic impurity, and usage history of the loop. Further, erosion, biting and self-bonding, as well as corrosion of bare metal without protective layer, should be taken into consideration. Solubility of iron, chromium, and nickel in the liquid sodium is sufficiently low so that these metals can be employed in practice. Solubility diagrams for metal, oxygen, and hydrogen in the liquid sodium, and free-energy diagrams for oxide formation and carbide formation are shown. Most carbides can be used as construction material to contain the liquid sodium. Advancement of liquid-sodium technology depends upon usability of stainless steel. An experiment on mass transfer of pure metal such as iron, nickel, chromium, and cobalt in a thermal-convection loop made of 316 SS, is reviewed. In actual nuclear reactors, transfer of metal activated in the reactor core becomes a problem, because the lifetime of cold traps is restricted; deposited induced radioactivity makes both maintenance and replacement difficult, rather than blockage with oxide. The hot steel test loop project has been restored at Oarai. Corrosion of Ni, V, Nb, Mo, graphite–C, UO_2, UC, etc. are summarized briefly. (JA)

16212 TRANSPORT AND DEPOSITION OF METALS IN SODIUM–STAINLESS STEEL SYSTEMS. 2. Radioisotope Distribution in a Natural Circulation Loop. Sagawa, N.; Iba, H.; Yato, Y.; Kawahara, S. (Hitachi Research Lab., Ibaraki, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 523-532(Sep 1973).

Transport and deposition of ^{54}Mn, ^{65}Zn, ^{124}Sb, and Cs radioisotopes in a natural-circulation sodium loop were studied over a temperature range from 630 down to 280°C. Movement of the radioisotopes during the loop operation were monitored by in situ counting and radiochemical analysis of sodium samples taken from the loop. Distribution of the radioisotopes along the cooling tube was determined after chill solidification of flowing sodium. Results indicate that manganese deposits on the substrate presumably by adsorption in the higher-temperature region and by precipitation in the lower-temperature region, zinc presumably by adsorption associated with plating in the lower-temperature region, antimony by coprecipitation with other deposits in the cold settling pocket, and cesium mainly by physical adsorption in the lower-temperature region. Significant deposition of the radioisotopes was observed in the pocket and the apparent rate constants of the deposition were obtained for manganese, zinc and cesium. (auth)

16213 FRICTION IN PAIRS OF TRANSITION METAL–REFRACTORY COMPOUNDS. Alekseev, V. I.; Koval'chenko, M. S.; Serebryakova, T. I. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 94-98(Nov 1973). (In Russian).

Results are presented of investigation of characteristics of friction and wear of technically pure titanium, tungsten, and cobalt by titanium, niobium, and tungsten monocarbides and titanium diboride in vacuum. It is established that in spite of a considerable difference in the initial hardness, metals evoke wearing of the refractory compound samples. The phase x-ray analysis of the wearing products of pairs Ti–NbC, W–TiB_2 reveal no chemical or diffusive interaction of the contacting materials. The influence of adhesive and polydeformation processes, relating friction to wear is established. (auth)

16214 NOVYE METODY ISSLEDOVANIYA KORROZII METALLOV. (New Methods For Investigation of the Corrosion of Metals). Rozenfeld, I. L. (ed.). Moscow; Izdatel'stvo Nauka (1973). 220p. (In Russian).

Twenty-eight papers on new methods of investigating the corrosion of metals and alloys are presented. Special attention is given to the physical and electrodynamic methods of studying corrosion. The application of potentiostatic methods, impedance measurements, and pulse polarization to the study of corrosion is discussed. Practical methods are described. (tr-auth)

Preparation and Fabrication

Refer also to abstracts 17718 and 18012.

16215 (HW-71278) QUALITY CONTROL STANDARDS. Coextrusion Process. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 9 Oct 1961. 150p. Dep. NTIS $9.50.

Declassified 8 Jan 1973.

A comprehensive summary of the limits and techniques is presented for control of the variables of the manufacturing processes for coextruded fuel element preparation. The limits contain the requirements of the engineering specifications and the additional controls needed to define fuel element quality level. The techniques contain the procedures, schedules, and controls normally required to achieve the fuel element quality specified in the limits. (auth)

16216 (N-73-24573) DEVELOPMENT OF THE WELD-BRAZE JOINING PROCESS. Bales, T. T.; Royster, D. M.;

Arnold, W. E. Jr. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Jun 1973. 42p. (NASA-TN-D--7281; L-8784). NTIS.

A joining process, designated weld-brazing, was developed which combines resistance spot welding and brazing. Resistance spot welding is used to position and align the parts, as well as to establish a suitable faying-surface gap for brazing. Fabrication is then completed at elevated temperature by capillary flow of the braze alloy into the joint. The process was used successfully to fabricate Ti-6 Al-4 V alloy joints by using 3003 aluminium braze alloy and should be applicable to other metal-braze systems. Test results obtained on single-overlap and hat-stiffened panel specimens show that weld-brazed joints were superior in tensile shear, stress rupture, fatigue, and buckling compared with joints fabricated by conventional means. Another attractive feature of the process is that the brazed joint is hermetically sealed by the braze material, which may eliminate many of the sealing problems encountered with riveted or spot welded structures. The relative ease of fabrication associated with the weld-brazing process may make it cost effective over conventional joining techniques. (STAR)

16217 PREPARATION OF SELF-SUPPORTING MONOCRYSTAL Ni-FILMS. Reichelt, K.; Luke, K. H.; Rey, M. (Institut fuer Festkoerperforschung, Juelich, Ger.). Nucl. Instrum. Methods; 114: No. 2, 405(1974).

The preparation of highly perfect monocrystal Ni-films for particle transmission studies is described. (auth)

16218 METAL MATRIX COMPOSITE FABRICATION BY LIQUID INFILTRATION. Banker, J. G. (Oak Ridge Y-12 Plant, TN). SAMPE Quart.; 5: No. 2, 39-46(Jan 1974).

A pressure-vacuum liquid infiltration process for fabricating metal-matrix composite materials was developed. The process was used to fabricate flat tensile bars and hoop-test rings of both magnesium/boron and aluminum/boron. The effects of processing parameters, matrix alloying, and boron surface coating on the tensile properties were evaluated. A matrix effectiveness factor of 1.1 was determined from magnesium/boron tensile data. Although protective coatings of both silicon carbide and boron nitride were used, all aluminum/boron composites evaluated exhibited matrix effectiveness factors less than unity, indicating that excessive filament degradation had occurred. (5 figures, 5 tables) (auth)

16219 ELECTRODEPOSITION OF CADMIUM-NICKEL ALLOYS FROM THE SULFATE BATH. Dambal, R. P.; Rama Char, T. L. Plating; 59: No. 12, 1145-1152(Dec 1972).

Electrodeposited alloys of cadmium and nickel are promising for the decorative and protective finishing of metals. Studies leading to a satisfactory plating system are described, and many related data are tabulated and plotted. Alloys containing 4 to 100% cadmium can be obtained and cathode efficiency is 33 to 100% with a limiting current density of 60 A/cm^2. Anode corrosion and structure of the deposits are also studied. (Corrosion Abstr.)

16220 MICROSTRUCTURE: PROPERTY CONTROL WITH POSTWELD HEAT TREATMENT OF Ti-6Al-6V-2Sn. Simpson, R. P.; Wu, K. C. (Air Force Materials Lab., Wright-Patterson AFB, OH). Weld. J. (N. Y.); 53: No. 1, 13s-18s(Jan 1974).

From 54th AWS annual meeting; Chicago, IL (2 Apr 1973).

A major limitation in the use of Ti-6Al-6V-2Sn (Ti-662) as a structural alloy is its poor weldability. After conventional postweld heat treatment, the weld has very low ductility. However, proper postweld heat treatment will develop good ductility and fracture toughness in welded Ti-662. It is important to develop the correct microstructure, since mechanical properties depend upon the morphology of the alpha phase. Superior tensile ductility and fracture toughness were achieved with a duplex alpha-plate structure produced by a triplex heat treatment of automatic GTA welded 0.125-in. sheet. Matching filler metal gave better properties than Ti-6Al-4V filler. (11 figures, 4 tables) (auth)

16221 SOLID-STATE AND FUSION RESISTANCE SPOT WELDING OF Td-NiCr SHEET. Moore, T. J. (Lewis Research Center, Cleveland). Weld. J. (N. Y.); 53: No. 1, 37s-48s(Jan 1974).

From 54th AWS annual meeting; Chicago, IL (2 Apr 1973).

Four welding schedules were evaluated using conventional resistance welding equipment. Both specially processed (unrecrystallized) and commercial TD-NiCr sheet (0.4 mm thick) were used. Welding parameters were selected in order to produce both solid state and fusion resistance spot welds. All mechanical tests of the weldments were conducted using a single-spot lap joint specimen after postheating at 1200°C for two hours in hydrogen. The feasibility of producing solid-state resistance spot welds was also demonstrated in thicker (1.6-mm) TD-NiCr sheet. Excellent results were obtained using a solid state resistance spot welding schedule and specially processed sheet. After postheating, the weld was indistinguishable from the base metal. In 1100°C stress-rupture shear tests, the welds were as strong as the base metal. Base metal failure, rather than weld failure, took place in the stress-rupture tests and the other mechanical tests that included room temperature and 1100°C tensile-shear, and room-temperature fatigue tests. Less satisfactory results were obtained using commercial sheet. A minimum heat input fusion spot weld could not be made without affecting the microstructure of the sheet. Solid-state spot welds, however, were produced without affecting sheet structure. But, for the solid-state welds, the weld plane was a stable grain boundary. Unsatisfactory results were obtained when a conventional fusion spot weld was made in commercial sheet. Within the nugget the fine thoria dispersion and the large grain structure of the sheet were lost. A valid stress-rupture curve could not be determined for this type of weldment. (21 figures, 5 tables) (auth)

16222 ELECTROLYTIC MAGNETIC Co-BASE ALLOYS. 11. On the Investigation of Co-W-Mn Alloys Electrodeposition During the Electrolysis of Sulfate Solutions. Rachinskas, V. S.; Orlovskaya, L. V.; Matulis, Yu. Yu. (Inst. of Chemistry and Chemical Technology, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 3: No. 76, 29-40(1973). (In Russian).

It was determined that the cathode potential of Co-W-Mn alloy plating shifts to more negative values, but limiting current densities, current efficiencies (η), and residual magnetism (I_r) of deposits decrease and both Mn and W percentages in deposits increase as the $CoSO_4$ concentration in the base decreases and both $MnSO_4$ and WO_4^{2-} concentrations in the electrolytes increase. The Mn percentage and η of coatings were found to increase and W percentage to decrease with increasing of current density and pH of electrolyte. As the thickness of coatings becomes lower (so does I_r and both W and Mn percentages in alloy), coercive force and coefficient of hysteresis loop increase. With the increase of Mn percentage in alloy, an increase in the amount of codeposited hydrogen is established. The conclusion has been drawn that the physical and chemical properties of deposits, obtained by the electrolysis of $CoSO_4$ solutions containing WO_4^{2-} and $MnSO_4$, mainly depend on the hydrogen evolving intension and on the degree of alkalinity of the solution layer adjacent to the cathode. (auth)

16223 DRAWING OF TUNGSTEN WIRES IN VACUUM AND IN INERT GAS. Zhilkin, V. Z.; Zhukov, A. V. Tsvetn. Metal.; No. 7, 76-77(Jul 1973). (In Russian).

The power parameters and the lubricating compositions during the drawing of W wires in Ar and in a vacuum of 1×10^{-2} mm Hg were investigated. The effect of the drawing medium on the mechanical properties of the wire was determined. (tr-auth)

16224 EFFECT OF ULTRASONIC OSCILLATIONS ON THE FORCE PARAMETERS OF THE DRAWING OF WIRES FROM HARD-TO-DEFORM METALS AND ALLOYS. Severdenko, V. P.; Klubovich, V. V.; Repin, R. A.; Konyshev, L. K. (Physical-Technical Inst., Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 3, 5-8(1973). (In Russian).

Results of an investigation of the drawing of wires from Mo, W, Ni, and Mn alloys are reported. The effect of ultrasonics on the degree of deformation during drawing is shown. The effect of speed on the drawing process with ultrasonics was investigated. (tr-auth)

16225 PREPARATION, STRUCTURE, AND MECHANICAL PROPERTIES OF LARGE Mo MONOCRYSTALS. Savitskii, E. M.; Burkhanov, G. S.; Raskatov, N. N.; Ottenberg, E. V.; Shnyrev, G. D.; Sergeev, N. N. pp 5-10 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

A plasma-arc melting method was used to produce molybdenum monocrystals with diameters of 15 to 35 mm. Metallographic studies of their fine structure and mechanical properties were made at room temperature. The studies showed that the purity, structure, and properties of these crystals were of the same grade as similar crystals produced by electric-arc zone melting. (tr-auth)

16226 PREPARATION OF Mo-BASE MONOCRYSTALLINE ALLOYS AND STUDY OF THEIR STRUCTURES AND MECHANICAL PROPERTIES. Bulgak, L. V.; Belomyttsev, Yu. S.; Savitskii, E. M.; Kapustin, V. D.; Saratovskii, L. N.; Pavlovich, T. M.; Auikov, V. A. pp 10-16 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel' stvo Nauka (1973). (In Russian).

Monocrystalline alloys of molybdenum with carbon, zirconium, niobium, and nickel were obtained by zone melting, and their structure and mechanical properties were studied. It was shown that high-temperature stability of monocrystalline molybdenum

may be increased by alloying it with small amounts of zirconium and niobium. Nickel had a good effect on the plasticity of molybdenum at room temperature and stability at high temperatures. (tr-auth)

16227 HEAT RESISTANCE OF PALLADIUM-PLATED MOLYBDENUM AND ANTIEMISSION PROPERTIES OF A PALLADIUM COATING ON MOLYBDENUM. Makarova, N. G.; Lainer, V. I.; Parusnikov, V. N.; Smironov, Yu. S. (Moscow Inst. of Steel and Alloys). Prot. Metals (USSR) (Engl. Transl.); 8: No. 6, 658-659 (1972).

Translated from Zashch. Metal.; 8: No. 6, 724-726(1972).

To determine the physical mechanism of the action of a Pd coating, an x-ray-diffraction investigation of grids treated in experimental tubes was conducted. Unfiltered λCrK_α radiation was used; the photographs were taken on a URS-60 apparatus, RKU-114M camera, D = 114.7 mm. On the x-ray diffraction picture, the lines of the intermetallic compound Pd_3Ba are sufficiently clearly revealed. The opinion exists that the formation of such a compound under the conditions of operation of a tube with grid temperature 500 to 600°C is relatively improbable and is possible at 900°C. It is concluded that the anti-emission properties of Pd, like those of Au, are determined by its ability to bond Ba atoms into a stable intermetallic compound with a sufficiently high electron work function. (auth)

16228 ELECTRODEPOSITION OF COPPER-CADMIUM ALLOY FROM SULFATE-ACETATE AND SULFATE-CITRATE ELECTROLYTES. Issa, I. M.; El Sheikh, F. A.; Nubi, G. (Assiut Univ., Egypt). Prot. Metals (USSR) (Engl. Transl.); 8: No. 6, 671-673(1972).

Translated from Zashch. Metal.; 8: No. 6, 736-739(1972).

The electrodeposition of Cu-Cd alloys from $CuSO_4$-$CdSO_4$ electrolytes containing acetic or citric acid was studied. The best electrolyte composition found contains (in g-equiv/l) $CuSO_4$, 0.2; $CdSO_4$, 0.5; citric acid, 1.0 and NH_4OH, 0.8. Electrolyte temperature 25 to 30°C and cathodic current density 0.25 to 0.75 A/dm^2 were optimal. (JRD)

16229 ELECTROLYTIC DEPOSITION OF A Cu-Cd ALLOYS FROM GLYCINE ELECTROLYTES. Issa, I. M.; El Sheikh, F. A.; Nubi, G. (Assiut Univ., Egypt). Prot. Metals (USSR) (Engl. Transl.); 8: No. 6, 674-675(1972).

Translated from Zashch. Metal.; 8: No. 6, 739-741(1972).

Optimum conditions for deposition were studied. Recommendations are included concerning electrolyte composition, anode-cathode separation distance, electrolyte temperature, and current density. (JRD)

16230 PROCEDURE FOR WELDING OF AN END CAP TO THE CAN OF A FUEL PIN. Guettler, R. (to Licentia Patent-Verwaltungs GmbH). German Patent 2,161,997. 28 Jun 1973. 7p. (In German).

The process concerns an autoclaved Zircaloy cladding tube. Before the welding process, the autoclave layer on the welding spot is removed by a length of 1 to 5 mm or two to three times the tube thickness. The cladding tube is clamped during the welding process by a massive clamping tool so that the front edges of the tool almost come together. (GE)

16231 INFLUENCE OF GAS-FLAME METALLIZATION PARAMETERS ON THE STRUCTURE AND PROPERTIES OF MOLYBDENUM COATINGS. Protasov, G. A.; Klyueva, K. D.; Govorin, E. V. Svar. Proizv.; No. 3, 6-7(Mar 1973). (In Russian).

The coatings deposited by gas-flame metallization using acetylene-oxygen flames were studied. The deposition of the coatings was done in a modernized apparatus MGI-2 with oxygen consumption of 1150 to 1270 l/h and acetylene consumption of 845 to 1050 l/h. Mo MCh-1 in the form of wires with a diameter of 1.5 mm was used for the deposition and steel St 3 was used for the backing. In the region of factor space use the deposition parameters statistically affect the hardness and porosity of the Mo coatings. The effect on the microstructure and the strength under tension is insignificant. An increase of the hardness can be attained by use of very high air pressure, increase of the oxygen content in the fuel mixture, decrease of the jet rate, and increase of the deposition distance. The porosity can be reduced by decrease of the oxygen content in the mixture, decrease of the deposition distance, and increase of the air pressure. (tr-auth)

16232 SELECTING THE HEAT TREATMENT CYCLE FOR REPEATED ACTION INDUCTORS OF Br.B2 BERYLLIUM BRONZE. Khrenov, K. K.; Sergeev, Yu. A.; Chuckov, V. A. Svar. Proizv.; No. 1, 72-73(1973). (In Russian).

On the basis of studies made the following regime for the heat treatment for repeated action inductors of Br.B2 beryllium bronze was recommended: homogenization at 750°C for 4 to 5 h, followed by oil hardening and then tempering at 350°C for 3.5 h. Fabrication by this method of repeated action inductors for magneto-pulse welds successfully passes industrial tests and can be used for the mass production of reducing pipes. (tr-auth)

16233 THERMAL INSULATION. Denis, R. (to Joint Inst. For Nuclear Research). Luxemburgian Patent 62,627. 18 Feb 1971. vp. (In German).

In nuclear reactors with concrete vessels the thermal insulation between the hot core and the concrete needs particular attention. The insulation should be compact, flexible, reliable, economic and capable of withstanding high temperatures (above 500°C). It consists of several superimposed chambers which are delimited by metallic foils and filled with metallic meshwork of extremely high porosity. The meshwork is made by superimposing several layers of knitted wires, the layers comprising a wave structure perpendicular to the layer surface. In adjacent layers the directions of the wave intersect. This material is commonly used to fill air filters. Pressure equalization between the chambers is achieved via the edges of mattresses into which the entire surface is subdivided in order to facilitate prefabrication. The mattresses are fixed to the wall by means of hollow bolts. (auth)

16234 OBTAINING OF COBALT-TUNGSTEN POWDER BY ELECTROLYSIS OF WATER SOLUTIONS. Yur'ev, B. P.; Privalova, A. M.; Zabelin, I. V. (Leningrad Polytechnic Inst.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 1-5(Nov 1973). (In Russian).

The process of electrolytic production of W-Co alloys in powdery form from citrate solutions containing Na_2WO_4 and $CoSO_4$ with additives $(NH_4)_2SO_4$ and Na_2SO_4 is examined. Effects of solution composition and electrolysis conditions on current flow and chemical composition of the powder are studied. Current flow increases with growth of total concentration of tungsten and cobalt salts and with decrease of citric acid in the solution. The chemical composition of the powder is affected most of all by the ratio of tungsten and cobalt salt concentration in the solution. If this ratio is changed the tungsten content in the alloy may be changed from 0 to 20% by mass respectively. Optimal conditions of W-Co powders electric precipitation are determined. X-ray diffraction analysis shows that these powders are the solid solutions of tungsten in hexagonal and cubic cobalt. (auth)

16235 METHOD OF ELECTROLYTICALLY REFINING ZIRCONIUM AND ZIRCONIUM ALLOYS. Wurm, J. G.; Heylen, P. R. Luxemburgian Patent 62,193. Dec 1970. (In French).

A method of electrolytically refining zirconium and zirconium alloys is described, in which the anode consists of crude zirconium or its carbide and the electrolyte is a mixture of molten salts containing a zirconium compound. This method is made continuous by conveying the cathode continuously through the electrolyte. The method makes it possible to obtain zirconium with a constant purity, the method being fully automated, and alloys can be produced if the cathode consists of or contains another metal than zirconium. (auth)

16236 COUPLED REDUCTION WITH PLATINUM GROUP METALS. The Preparation of High-Purity Rare Metals. Berndt, U.; Erdmann, B.; Keller, C. (Kernforschungszentrum, Karlsruhe, Ger.). Platinum Metals Rev.; 18: No. 1, 29-34(Jan 1974).

Very pure metals of the actinide, lanthanide, and alkaline earth series can be prepared from their oxides by coupled reduction by hydrogen in the presence of platinum group metals. During the process, the platinum group metals form intermetallic phases with the metals from the oxides. These phases are decomposed to yield the pure metals in gaseous form and the platinum group metals in solid form. The pure gaseous metals condense to produce pure solid specimens. (auth)

16237 SEALED CONTAINER HAVING A ZIRCONIUM-TIN ALLOY GETTER. Gulbransen, E. A.; Jansson, S. A. (to Westinghouse Electric Corp.). US Patent 3,762,995. 2 Oct 1973. Filed date 30 Apr 1968. 10p.

A getter system is described for gases contained within a hermetically sealed container. The gases include those dissolved in the container walls which are to be maintained substantially free of such gases. Disposed in the container is a body heatable to an elevated temperature which requires protection from residual gases. The getter consists essentially of a zirconium-base alloy containing about 10 to 30 weight per cent tin. (Official Gazette)

16238 LASER WELDING OF A SIMULATED NUCLEAR REACTOR FUEL ASSEMBLY. Estes, C. L.; Turner, P. W. (Union Carbide Corp., Oak Ridge, TN). Weld. J. (N.Y.); 53: No. 2, 66s-73s(Feb 1974).

From 53rd AWS annual meeting; Detroit, MI (10 Apr 1972).

A pulsed ruby laser was evaluated for welding a simulated nuclear reactor fuel pin bundle to a tube sheet. Tube-to-tube sheet welds joined AISI 304 tube sheets to AISI 316 tubular assemblies which were arranged in a unique, close-packed configuration causing the joints to be inaccessible for joining by conventional

welding processes. The electron beam process was also evaluated and was eventually selected instead of the laser process for fabricating experimental tube bundles. This choice was justified because a subsequent change in joint efficiency (deeper penetration) made it impractical to use the existing laser welding machine. A detailed coverage of the development of the electron beam welding procedure is not presented because it is not within the scope of this paper. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 15245, 15345, 15444, 15472, 15473, 16166, 17064, 17083, 17577, 17580, 17998, 17999, 18004, 18006, 18007, 18010, and 18015.

16239 (BMI-X-639) CHARACTERISTICS OF COMMERCIAL VACUUM-HOT-PRESSED BERYLLIUM. Part II. Summary Report. Gelles, S. H. (Battelle Columbus Labs., Ohio (USA)). Dec 1972. 67p. (UCRL-13589). Dep. NTIS $5.50.

For Univ. of California, Livermore.

Tensile property evaluations of hot-pressed beryllium blocks revealed the presence of embrittlement in the pressing direction at 500°F at a strain rate of 0.0385 per minute. The embrittlement was found to be exaggerated at a strain rate of 38.5 per minute, also occurring at 300°F. It was traced to the excessively high yield strength of this material and was felt to originate from a combination of fine grain size and impurity locking. The comparatively low ultimate strength in the pressing direction, a result of preferred crystallographic orientation, was another key factor leading to the embrittlement in the pressing direction. The effect of strain rate on the tensile properties of hot-pressed blocks 21 and 24 was investigated further. Mild manifestations of embrittlement were revealed in these materials at a strain rate of 38.5 per minute. Negative or very low strain-rate sensitivities in yield and ultimate tensile strengths found in hot-pressed block 21 at intermediate strain rates and at temperatures between ambient and 500°F were interpreted as evidence of strain-aging behavior. A transmission-electron-microscopy investigation of hot-pressed block 20 revealed the general presence of long straight dislocations after pressurization to 20.3 kbar. This observation was used to explain qualitatively the removal of the yield point by pressurization. (auth)

16240 (CEA-CONF-2358) METHOD FOR STUDYING THE TEXTURE OF REACTOR MATERIALS. Lefranc, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). 1973. 9p. (In French). (CONF-730571-2). Dep. NTIS (U. S. Sales Only) $3.00.

From colloquium on x rays and matter; Monte Carlo, Monaco (22 May 1973).

The texture of reactor materials was determined using the inverse pole figure method. The terms of the ideal orientations A, C, D are used in conjunction with this technique together with the cumulative Schmid factor in order to determine a correlation between the elastic limit and the texture. Two different types of sample holder, already developed for studying the texture of uranium, were used for this purpose: the first type has a continuous rotary motion and the second a to-and-fro motion. A more rapid method was developed for determining the preferential orientation of pressure tubes. This method has the advantage of being nondestructive and permitting any complementary examination to be carried out. (FR)

16241 (CONF-730942-P5, pp vp Paper L 3/4) COMPLEX-STRESS CREEP RELAXATION OF METALS AT ELEVATED TEMPERATURES. Henderson, J. (National Engineering Lab., Glasgow). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Many engineering components, such as bolted flanges, press-fit elements, and springs are subject to creep relaxation, the initial loading strain remaining constant with time, and subsequent creep strain manifesting itself by an interchange of elastic strain for creep strain, resulting in diminishing stress with time. Further it is recognised that understanding of the behavior of components under conditions of thermal stress, stress relieving treatment, and stress redistribution in complex and welded elements must involve a knowledge of the manner by which complex stress conditions are altered by creep relaxation processes. Thus methods for the prediction of complex stress relaxation of metals are a prerequisite for advanced design such as might be expected for the nuclear reactor industry. The four metals tested at elevated temperatures are considered to span a reasonable spectrum of engineering alloys; these are a 0.24% C steel at 450°C, a commercially pure copper at 250°C, an aluminium alloy at 200°C and a magnesium alloy at 50 and 20°C. Combined tension–torsion relaxation tests were made on thin-walled tubular specimens of the metal concerned which, with the conventional assumptions of volumetric constancy, enabled those tests to be considered representative of complex-stress conditions in general. The study has shown that simple, manually controlled tensile relaxation tests can provide a satisfactory prediction of complex stress relaxation. Where only tensile primary creep data are available, however, the strain-hardening form of the appropriate complex stress creep equation, derived from the tensile data, leads to reasonably accurate prediction of the complex stress relaxation results. (auth)

16242 (CONF-730942-P5, pp vp Paper 3/6) NEW THEORETICAL AND EXPERIMENTAL RESULTS IN PLASTICITY AND CREEP. Phillips, A. (Yale Univ., New Haven). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Plastic strain vectors and primary creep strain vectors are presented as functions of the motion of the yield surface during hardening. The existence of plastic and creep strains which are "negative" (e.g., directed towards the origin of the stress and strain spaces is shown). An analytical formulation is given for the hardening law. This law is in fact a generalization of the phenomenon of lack of cross effect, a phenomenon observed previously by some experimentalists and disputed for considerable time by others. It was not universally observed previously, not even for the limited number of stress paths considered by many other authors because the definition of yielding introduced by these authors did not make it possible for them to make the observation. (auth)

16243 (CONF-730942-P5, pp vp Paper L 3/7) BILINEAR REPRESENTATIONS OF STRESS-STRAIN BEHAVIOR OF TYPES 304 AND 316 STAINLESS STEEL CYCLICALLY DEFORMED AT 800 TO 1200°F. Cheng, C. F.; Cheng, C. Y. (Argonne National Lab., IL). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Creep is significantly affected by temperature and loading conditions; thus, the design rules for nuclear components in Section III of the ASME Boiler and Pressure Vessel Code and ASME Code Case 1331 require inelastic analysis be performed to show that the levels of stress and strain are acceptable under given criteria. Generally, this requires a combined time-dependent creep analysis and time-independent elastic-plastic analysis in which creep and elastic-plastic behaviors are simultaneously considered. Such a combination of analyses is capable of predicting stresses, total strains accumulated, and deformations as functions of time for any random load and temperature history. In the case of elastic-plastic analyses of Fast Flux Test Facility (FFTF) components, the tentative RDT Standard F9-1 recommends that the bilinear stress–strain relationship and the classical kinematic hardening model be used with the von Mises or the Tresca yield criterion and the associated flow rule of von Mises. This paper presents the bilinear representations of the elastic-plastic strain-hardening behavior of Types 304 and 316 stainless steel under cyclic loading conditions. The data were obtained from fully reversed, axially strain controlled low-cycle fatigue tests in air at 800–1200°F, and at 4×10^{-3}–4×10^{-6} sec^{-1} strain rate. The effects of maximum strain, temperature, heat treatment, and tension hold time on bilinear hardening functions κ (a measure of yield surface) and coefficients C (as related to von Mises flow law) were evaluated. These hardening coefficients and functions are discussed in relation to the work hardening that accompanies cyclic deformation. Based on the limited low-cycle fatigue data, the conclusions are as follows: (1) With or without tension hold time, the hardening functions κ_0, κ_1, and κ_s (subscripts 0, 1 and s denote monotonic and cyclic at 10th cycle and saturated stress cycle, respectively) increase with ϵ_{max} ($\Delta\epsilon_t/2$), and all three hardening functions converge at ~0.25% ϵ_{max}. (2) No discernible temperature trend was observed in tests without tension hold times for the cyclic hardening functions κ_1 and κ_s. Only the monotonic hardening function κ_0 increases as the temperature decreases at the same ϵ_{max}. (3) Values of κ_1 and κ_s for the annealed condition are either equal to or greater than the annealed-and-aged condition in tests without tension hold time. (4) The family of tension-hold time curves also shows κ_s decreases as ϵ_{max} decreases, and they converge at ~0.25% ϵ_{max}. (5) The bilinear hardening coefficient C (calculated from monotonic tensile data) decreases as ϵ_{max} increases. Above 0.5% ϵ_{max}, the deviation of C from the arithmetic average over a temperature range from 800 to 1200°F appears significant. (auth)

16244 (CONF-730942-P5, pp vp Paper L 3/10) LARGE DEFORMATION ANALYSIS OF CRYSTALLINE ELASTIC-VISCOPLASTIC MATERIALS. Bhandari, D. R.; Oden, J. T. (Univ. of Alabama, Huntsville). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The thermodynamics of crystalline elastic-viscoplastic materials developed earlier by the authors (Nuclear Engineering and Design, to appear) is extended to account for finite-strains. The present theory utilizes the basic physical concepts derived from the theory of dislocations in crystals and the thermodynamics of continua with internal state variables. A crystalline simple solid is considered to be a homogeneous elastic-plastic continuum containing dislocations which constitute the intrinsic, internal mechanism of plasticity phenomena. The appropriate internal state variables and the basic constitutive relations for the description of the elastic-viscoplastic behavior are deduced from the consideration of dislocation dynamics. The proposed theory is based on the assumption that both elastic and inelastic deformations take place at every stage of loading and unloading. This assumption has a definite physical basis and is the underlying consideration in the field of dislocation dynamics. Unlike other theories, the present one does not require the specification of a yield criterion or the prior determination of whether the material is loading or unloading. It can be shown that under appropriate assumptions on the constitutive laws the present theory reduces to the case of classical thermoelasticity or thermoplasticity. The general finite-element formulation of an initial-boundary value problem is briefly presented. A specific example is carried out in detail which involves the solution of equations governing the coupled thermomechanical response of titanium. To demonstrate the effectiveness of the present formulation, a scheme for calculating the deformations, the stresses and temperature distribution is developed and applied to a three-dimensional structure subjected to high temperature, surface heat flux, volume heat supply as well as mechanical loading. The theory and the analysis should be beneficial in the study of the behavior of reactor materials at high temperatures. (auth)

16245 (CONF-730942-P5, pp vp Paper L 4/8) NUMERICAL METHOD TO DESCRIBE UNLOADING IN DYNAMIC PLASTICITY. Cristescu, C. (Inst. of Atomic Physics, Bucharest); Cristescu, N. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A program to be used to describe dynamic plastic deformation followed by elastic unloading is presented. Two kinds of such programs are presented which correspond to two basic plastic models used in plasticity theory: the classical nonviscous model and the rate-dependent one. The main difficulty of the problem is that in the plastic region a quasi-linear system of equations is used, while in the elastic region a linear one. The finding of the boundary between the two regions is the main objective of the program. Together with this boundary, which is obtained with the computer (for the first time in the literature), are obtained the solutions in both elastic and plastic regions. For the first time one has available a method allowing the solving of this problem for any initial or boundary conditions and any constitutive law as well. Since in the plastic region the slopes of the characteristic lines are variable and since one has to change abruptly the slope of the characteristic line when passing from the elastic to the plastic region and vice-versa, one introduces the following (new) method: in every single point the first iteration of the solution is the local "elastic" solution in that particular point. The true solution is then obtained by iteration. The method is very efficient, few iterations being necessary in each point. The method has been used since 1969 for the study of dynamic plastic deformation of aluminium assumed to satisfy a plastic nonviscous constitutive equation. Further the method has been adopted for plastic rate-dependent models which may describe dynamic relaxation and creep as well. (auth)

16246 (CONF-730942-P5, pp vp Paper L 8/1) EFFECT OF HOLD TIME ON ELEVATED-TEMPERATURE LOW-CYCLE FATIGUE. Ohtsuka, N. (Chiyoda Chemical Engineering and Construction Co. Ltd., Kawasaki, Japan). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The periodic time in low-cycle fatigue tests at elevated-temperature is extremely shorter, in general, than in practical structures and has an important effect on the fatigue life. In order to investigate the effect of time, isothermal fatigue tests were conducted on Type SUS32PH (equivalent to AISI 316) stainless steel at room temperature, 550°C, and 800°C, and on 1 Cr-$\frac{1}{4}$ Mo steel, SCM3, at the temperature of 550°C, using an electro-hydraulic servo-control universal thermal fatigue testing machine. The specimens were maintained the desired strain range throughout the test and kept the strain constant during the tensile and compressive hold times ranging from 0.3 to 995 seconds. A considerable reduction in fatigue life was observed when the test temperature was raised and the hold time period was increased. The linear fraction rule between creep and fatigue damage was compared with the experimental results, and it was found that there lie several problem points of significance in the rule, especially in relation to cyclic softening materials such as SCM3 steel. Therefore, it was considered that the creep effect did not so seriously dominate over the strain-controlled fatigue life at elevated-temperature and discussed further as follows. In case of corrosion fatigue, Endo et al. assumed that reduction of fatigue strength with decreasing the cycle frequency was due to the notch effect of corrosion pits, and indicated that various experimental results were well explained by applying the corrosion effect or notch effect, K, which is the ratio of the fatigue strength in air to the one under corrosion at the same number of cycles. Modifying this criterion to low-cycle fatigue at elevated temperature, the following life evaluating equation formulating the relationships among the cyclic dependency effect by fatigue damage, the time dependency effect by oxidation, and the combined effect, was developed from a study of the experimental results: $(1 + B \cdot t_0^{n_1} \cdot N_f^{n_2}) \cdot \epsilon_{pR}^{\alpha_0} \cdot N_f^{\alpha_0} = C_0$ where t_0, ϵ_{pR}, and N_f are the hold time during a half cycle, plastic strain range, and the number of cycles to failure, respectively, and B, n_1, n_2, α_0, and C_0 are constants. The time dependency effect may be interpreted also to include other supplementary effects such as creep damage and deterioration of materials. (auth)

16247 (CONF-730942-P5, pp vp Paper L 8/3) EFFECT OF BIAXIAL STRESSES AND COMBINED STRESSES ON FATIGUE AND FRACTURE. Roberts, R.; Pothiraj, S. (Lehigh Univ., Bethlehem, PA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Recent studies by Erdogan et al. and Kibler et al. have considered the problem of fatigue and fracture of thin shell structures. Along with theoretical determination of stress-intensity factors for thin shells and broad discussions of possible fatigue crack propagation and fracture models, these studies presented experimental data on fatigue and fracture of thin shells. Particular emphasis was placed in these studies on the effects of biaxial stresses on fatigue and fracture in thin shells and on combined stresses (extensional plus bending) on fatigue crack propagation. The effects of biaxial stresses on fatigue crack propagation and fracture and the effect of combined stresses on fatigue crack propagation are re-examined. The portion of the study dealing with biaxial stress effects considered these effects on 7075-T6 aluminium which had not been previously studied. A series of Photostress experiments were also carried out to help explain the observed fatigue and fracture behavior. In general there was good agreement with previous studies on 6000 series aluminum. The biaxial stress field significantly changed the maximum load at fracture as previously observed. However, the results of the fatigue crack propagation tests and a careful study of previous work indicate that for the type of biaxial loading considered, biaxial stresses do not significantly change fatigue crack propagation behavior. In the portion of this study dealing with combined load effects, a series of critical experiments were undertaken in an effort to more fully understand the effect of combined loads on fatigue crack propagation. These tests produced a wider variation in the ratio of bending to extensional stress than previously considered in other studies, thus allowing a more meaningful correlation between theory and experiment. Contrary to previous studies which proposed that the fatigue crack propagation due to combined loads could be handled by an equivalent stress-intensity factor range defined as $\Delta K_e = \Delta K_T + (\Delta K_B/2)$, the present study indicates the equivalent stress-intensity factor range should be defined as $\Delta K_e = \sqrt{[(\Delta K_T)^2 + (\Delta K_B/2)^2]}$ where ΔK_T and ΔK_B are the extensional and bending stress-intensity factors respectively. (auth)

16248 (CONF-730942-P5, pp vp Paper L 8/4) SENSITIVITY OF FATIGUE LIFE PREDICTIONS TO APPROXIMATIONS IN THE REPRESENTATION OF METAL CYCLIC DEFORMATION RESPONSE IN A COMPUTER-BASED FATIGUE ANALYSIS MODEL. Conle, A.; Topper, T. H. (Univ. of Waterloo, Ont.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

As part of a general program to develop methods allowing results of simple tests to be applied to the fatigue and analysis of complex structures subjected to random loading, a computerized model was developed to simulate material cyclic deformation and fatigue behavior. When a nonlinear analysis for local stress and strain at stress concentrators is incorporated in this model, it accurately predicts the fatigue life of randomly loaded notched components. Input data required for the model are quantitative descriptions of such basic features of material behavior as mem-

ory of prior deformation, cyclic hardening and softening, cyclic mean stress relaxation, and fatigue life. The stepwise calculations utilize a nonlinear analysis for deformation at geometrical notch roots. A quantitative evaluation of the assumptions used in the model was obtained from a comparison of the results of several types of simulations with actual specimen results. The prerequisite material information used in the model was obtained from constant strain amplitude tests of smooth specimens and constant load amplitude tests of notched specimens. Both specimen types were machined from a boron steel plate. Tests in which random straining sequences were applied to smooth specimens and random loading sequences to notched specimens were then performed using a small on-line digital computer to control an electrohydraulic testing machine. Fatigue predictions for the two sample types were then made for these straining or loading sequences using the simulation model. Several simplifications in the representation of material behavior were effected and the sensitivity of fatigue predictions to these simplifications evaluated. Smooth specimen evaluations were carried out both with and without cyclic mean stress relaxation and cyclic softening and with two different fatigue damage parameters. Similar simplifications were evaluated in the fatigue simulation for notched specimens and, in addition, both a constant value of the fatigue concentration factor K_f and a value of K_f which was a function of applied nominal stress were used in the nonlinear "Neuber's Rule" analysis for notch deformation. (auth)

16249 (COO-3476-7) APPLICATIONS OF MICRODYNAMICS AND LATTICE MECHANICS TO PROBLEMS IN PLASTIC FLOW AND FRACTURE. Progress Report, January 1, 1973–December 31, 1973. Bilello, J. C. (State Univ. of New York, Stony Brook (USA). Coll. of Engineering). 1973. Contract AT(11-1)-3476. 19p. Dep. NTIS $3.00.

Dislocation motion in the initial stages of plastic flow for as-grown and ultrahigh-vacuum-outgassed tungsten single crystals was studied by a low-frequency microstrain technique over the temperature range from 4.2 to 300°K. In terms of the observed elastic limit, aneiastic limit, and the fractional energy dissipation, the effects of purity, temperature, and stress amplitude on the frictional stress for dislocation motion are discussed. In the high-frequency regime, ultrasonic attenuation measurements in copper and copper–nickel alloys reveal a linear dependence of the velocity-dependent damping coefficient on the dislocation density. Effects of alloying are most pronounced for the early stages of alloy addition. In copper crystals constrained by the presence of an inherent polycrystalline layer, the barrier to dislocation motion at the surface enhances secondary slip in the bulk of the material, thereby producing a significant strengthening effect. (auth)

16250 (JUL-991-TP) VOLUME DIFFUSION IN THE MOLYBDENUM–TUNGSTEN SYSTEM. Erley, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Technische Physik). Aug 1973. 97p. (In German). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis. Submitted to Technische Hochschule, Aachen.

Tungsten–molybdenum single-crystal pairs were annealed in the temperature range from 1,900 to 2,250°C in high vacuum for 100 hours. Following corresponding metallurgical treatment, the concentration profiles were measured with an electron beam microprobe and from these, the concentration-dependent chemical diffusion coefficient $\tilde{D}C_{mo}$ for relative Mo concentrations C_{mo} between 0.1 and 0.9 was determined using the Boltzmann–Matano method. For $C_{mo} = 0$ and $C_{mo} = 1$, the coefficient of diffusion was determined according to the so-called "thin-layer" method. For the non-determinable concentration range ($0 < C_{mo} < 0.1$) or ($0.9 < C_{mo} < 1$), it was possible to extrapolate to obtain an expression for the chemical diffusion coefficient over the whole concentration range. From the impurity diffusion coefficients, the self-diffusion coefficients of tungsten or molybdenum, and from "tracer" diffusion coefficients of molybdenum in various W–Mo alloys in the literature, and with the help of an empirical relationship for "tracer" diffusion coefficients in dense mixable bimaterial systems, concentration- and temperature-dependent "tracer" diffusion coefficients of tungsten or molybdenum can be given. These relationships, in addition, are confirmed by the diffusion coefficients obtained from Kirkendall measurements. From the "tracer" diffusion coefficients, the chemical diffusion coefficient was calculated according to L. Darken, taking the thermodynamic factor and void flow factor into consideration. Comparison with experimentally determined chemical diffusion coefficients showed good agreement. (49 references, 31 figures, 13 tables) (GE)

16251 (RFP-1704) TENSILE PROPERTIES OF BARE-ROLLED INGOT-SHEET BERYLLIUM FROM ROOM TEMPERATURE TO 800°C. Miley, D. V.; Brugger, R. P. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 13 Dec 1973. Contract AT(29-1)-1106. 22p. Dep. NTIS $4.00.

Tensile properties of bare-rolled ingot-sheet beryllium from room temperature to 800°C are reported. While strength values show a steady decrease above room temperature, tensile elongations exhibit peaks at approximately 300 and 700°C. The strain-hardening exponent varies with temperature and amount of strain, and ranges between approximately 0.10 and 0.26. Metallographic examinations reveal cleavage fracture at the lower temperatures, accompanied by severe grain deformation above room temperature. This is followed by a temperature range in which ductile rupture occurs, and finally, at the higher temperatures, grain-boundary failure. The low BeO content of this material and the post-rolling heat treatment given to the sheet are factors which improve the high-temperature ductility as compared to other grades of beryllium. (auth)

16252 (RFP-2091) INGOT BERYLLIUM-MICROSTRUCTURAL AND MECHANICAL PROPERTY CHANGES DURING CAN-ROLLING. Heiple, C. R.; Dolechek, L. F. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 21 Dec 1973. Contract AT(29-1)-1106. 12p. Dep. NTIS $4.00.

Microstructural and mechanical property observations of ingot-source beryllium at selected points in the can-rolling process are reported. Recrystallization occurs concurrently with rolling at temperatures above 1800°F, and only partial recrystallization is observed during reheats at 1400°F. Most grain refinement induced by the rolling schedule occurs in the first 15 rolling passes. These represent 88 percent reduction from the ingot. A relatively small contribution comes from the final six passes which bring the total reduction from the ingot to 95 percent. Information was also obtained on the effects of the rolling schedule on the properties of the stainless steel can. (auth)

16253 REMARKS ON THE CONDITIONS FOR MAGNETIC INSTABILITIES IN ACTINIDES: STRONG CORRELATIONS. Continentino, M. A.; Gomes, A. A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 9, 161-191(1973).

A Hubbard-like approximation is adopted in order to calculate the response to an external q-dependent magnetic field. A previous calculation is extended to the case of a two band (d and f) with intra- and interband Coulomb interactions. An essentially different aspect is that one has d–f hybridization. (JFP)

16254 ONE-ELECTRON PROPAGATORS FOR ACTINIDE METALS: STRONG CORRELATION LIMIT. Continentino, M. A.; Gomes, A. A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 5, 87-107(1973).

The calculation of one-electron propagators in a strongly correlated limit is discussed in detail. An improved Hubbard-like approximation is adopted. The equations of motion for the propagators are derived and solved using the Fourier transformation, and the self-consistency problem is briefly discussed. (JFP)

16255 REMARKS ON THE EFFECT OF s–d MIXING IN THE SPIN POLARIZATION: HARTREE–FOCK APPROACH. da Silva, X. A.; Gomes, A. A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 8, 145-160(1973).

The calculation of Giovannini et al is extended to include the k,k' dependence of the exchange coupling and the existence of hybridized s and d bands. This picture seems adequate to describe the situation encounter in rare-earth metals, alloys, and intermetallics. The Hartree–Fock approximation is conserved. An explicit expression for the effective exchange couplings in terms of bare exchange parameters and of the band structure is found. The methods that should be used for numerical computation are briefly indicated. (JFP)

16256 MAGNETIC PROPERTIES OF NICKEL ALLOYS WITH ZIRCONIUM, NIOBIUM, AND TUNGSTEN. Evdokimova, A. D.; Sokolovskaya, E. M. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 5, 591-595(1973). (In Russian).

The saturation magnetization and Curie point of nickel–zirconium alloys were found to decrease with zirconium content. The saturation magnetization and Curie point are given by the formulas $(\sigma^{alloy}/\sigma^{Ni}) = \exp(-g/g_b)$, and $(\theta^{alloy}/\theta^{Ni}) = 1 - g(\partial/\partial g)(\theta^{alloy}/\theta^{Ni})$. Triple alloys Ni–Zr–Nb and Ni–Zr–W were shown to be mechanical mixtures, the total content of Zr, Nb, and W additions being 5 to 10 at.%. (auth)

16257 INFLUENCE OF HEAT TREATMENT ON MICROSTRUCTURE, TEXTURE, AND MECHANICAL PROPERTIES OF SEMI-FINISHED ZIRCALOY. Dressler, G.; Richter, H. (Metallgesellschaft, AG, Frankfurt am Main). (1973). vp.

From symposium on thermal treatment of the Deutsche Gesellschaft fuer Metallkunde; Bad Nauheim, Ger. (18 Oct 1973).

Starting from the microstructure composition at annealing and

hot forming temperatures resulting from phase transformations and intermetallic precipitations, the most important aspects in the production of semi-finished Zircaloy are dealt with. Following the characterization of the cold-formed state, the possible changes due to heat treatment of the mechanical properties in connection with the recovery and recrystallization processes thus occurring, as well as the changes in texture are presented. Importance of the knowledge in practice is described with special consideration to the property variations on a large production scale. (GE)

16258 THEORY FOR ELASTIC PROPERTIES OF DYSPROSIUM ANTIMONIDE. Ray, D. K.; Young, A. P. (Lab. of Spectrometric Physics, Grenoble, France). J. Phys., C (London); 6: No. 23, 3353-3358(27 Nov 1973).

The elastic constants of DySb near its 9.5°K phase transition are calculated using a simple model for the states of the Dy ions. Good agreement with experiment is obtained above the transition but there are large discrepancies in the low-temperature phase. It is argued that this disagreement is not a consequence of the model for the states. (auth)

16259 THERMAL CONDUCTIVITY OF A U–10 WT % Mo ALLOY BETWEEN 320 AND 680°K. Roy, C.; Radenac, A.; Cado, F. (CEA, Montrouge, France). J. Nucl. Mater.; 48: No. 3, 369-371(Oct 1973). (In French).

The thermal conductivity was measured by comparing the conductivity of the sample with that of a material of known conductivity (Armco Fe). Results show that thermal conductivity of the cast alloy is practically the same as that given in the literature. (JSR)

16260 INTERDEPENDENCE OF ACTIVATED SINTERING AND ACTIVATED RECRYSTALLIZATION WITH ELECTRON STRUCTURE. Panin, V. E.; Itin, V. I.; Duderev, E. E.; Ovcharenko, V. E.; Kochepasov, I. I. (Scientific-Research Physical Technical Inst., Novosibirsk, USSR). Phys. Sintering; 5: No. 2/2, 239-249(1973). (In Russian).

From third international round table meeting on sintering; Herceg Novi, Yugoslavia (3 Sep 1973).

A correlation was established between mutual solubility, activated recrystallization, and activated sintering and their connection with the electron structure of the components. In Ni–W and Ni–Mo compositions, there is intense solubility of Mo and W in the Ni. Alloying the Ni with Cu, Al, Mn, and Fe reduces this solubility. The reduced solubility of W in Ni during its alloying resulted in a decrease of the activating capacity of the Ni both during sintering and recrystallization. (JSR)

16261 SCHMID'S LAW DEVIATION IN MOLYBDENUM. Ayres, R. A.; Stein, D. F. (Michigan Technological Univ., Houghton). Mater. Sci. Eng.; 13: 223-229(1974).

The critical resolved shear stress (CRSS) is dependent upon the test axis in bcc metals. Effects due to substructure or impurity variation on the yield stress were carefully separated from the true orientation dependence by growing Mo single crystals along the ⟨110⟩ axis so that specimens having either a ⟨100⟩ or ⟨110⟩ tensile axis could be prepared from the same parent single crystal. The yield strength of the crystals was then measured as a function of temperature from 78 to 298°K. It was found that the CRSS in the ⟨110⟩ tensile axis was 30% greater than for the ⟨100⟩ tensile axis when tested at 78°K. This result differs from crystals grown along a specific axis and then mechanically tested along the same axis. Results indicate that much of the orientation effect of previous work is actually due to a variation in the impurity content of test specimens. (12 figures) (auth)

16262 PLASTIC DEFORMATION AND FRACTURE OF Fe–V ALLOYS. Jellison, J. L.; Stoloff, N. S. (Rensselaer Polytechnic Inst., Troy, NY). Mater. Sci. Eng.; 13: 231-243(1974).

A study of yielding, slip character, and ductility of quenched unalloyed iron and several Fe–V ferritic alloys was carried out in the temperature range of –269 to 25°C. The mechanical properties of unalloyed iron were shown to be markedly influenced by cooling rate from the annealing temperature or by low-temperature aging. Fe–V alloys, on the other hand, are unaffected by such treatments. Alloy softening in Fe–V ferrites results from the removal of carbon and nitrogen from solution in the melt or at the annealing temperature. Vanadium also scavenges oxygen, thereby suppressing intergranular fracture in quenched coarse-grained ferrite. The ductile-to-brittle-transition temperature of each alloy is shown to coincide with the temperature at which slip character changes from wavy to planar glide. Vanadium suppresses wavy glide in a manner analogous to lowering the test temperature. (14 figures) (auth)

16263 STRUCTURE AND MECHANICAL PROPERTIES OF STRESS-ORDERED Ni_4Mo. Chen, K. C.; Ling, F. W.; Starke, E. A. Jr. (Georgia Inst. of Tech., Atlanta). Mater. Sci. Eng.; 13: 255-262(1974).

The ordering of Ni_4Mo by isothermal annealing with and without an applied stress at 700°C was studied. The microstructural features developed during ordering were correlated with the mechanical properties. Ordering under an applied stress affects both the kinetics and the number of c-axes variants which exist within any one grain. The number of variants has an influence on the mechanical behavior. (auth)

16264 MECHANICAL BEHAVIOR OF A DIRECTIONALLY SOLIDIFIED AND THERMALLY COARSENED Pb–Cd EUTECTIC. Barclay, R. S.; Winegard, W. C. (Univ. of Guelph, Ont.). Mater. Sci. Eng.; 13: 291-293(1974).

The effect of annealing at 225°C for 12 to 96 hours on the mechanical behavior of lamellar Pb–Cd eutectic was studied. The interphase area per unit volume(s) was measured, and the coarsening was plotted as $1/S_v - 1/S_0$ vs time, where S_0 = original S and S_v = S after annealing. The plot is a straight line and compares favorably with the coarsening model of Graham and Kraft. The tensile behavior show that the alloys exhibit a Hall–Petch relation with the proportional limit and strength decreasing as a function of $\sqrt{S_v}$. (DLC)

16265 MAGNETIC AFTER EFFECTS IN ALLOYS OF SAMARIUM WITH COBALT AND COPPER. Savina, E. A.; Mishin, D. D.; Grechishkin, R. M.; Lagutin, A. E. (Ural State Univ., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 125-126(1973). (In Russian).

Results of the investigation of the investigation of the domain structure and magnetic aftereffects in the high coercive alloy $SmCo_{3.5}Cu_{1.5}$ were reported. In the demagnetized state on the base surface of particles with a diameter of 0.1 to 0.5 mm, a simple structure of domains with antiparallel orientation of the magnetization was observed. The typical dependence of the critical field under which magnetic reversal of monocrystalline particles was initiated on the magnetizing field was shown. The studies showed that the process of reverse magnetization of small crystals of $SmCo_{3.5}Cu_{1.5}$ in the high-coercive state proceeds in dependence on the size of the external magnetizing field. (JSR)

16266 IMPURITY SEGREGATION TO GRAIN BOUNDARIES. Joshi, A. (Brookhaven National Lab., Upton, NY); Stein, D. F. J. Test. Eval.; 1: No. 3, 202-208(May 1973).

Minute quantities of impurities present in a material can have a major influence on the mechanical, chemical, or electrical properties of materials when they are segregated in localized regions. Since grain boundaries are often the preferred regions for segregation, it is not surprising that the properties of grain boundaries differ from the bulk resulting in such phenomena as intergranular fracture and intergranular corrosion. The objectives of this paper are to demonstrate the usefulness of Auger spectroscopy in determining segregation, the role of segregation in the deterioration of properties, and to discuss our present understanding of the mechanisms for segregation. (9 figures, 37 references) (auth)

16267 NUCLEAR MAGNETIC RESONANCE STUDY OF $NbBe_x$ COMPOUNDS. Bennett, R. A.; Hooper, H. O. (Wayne State Univ., Detroit). J. Solid State Chem.; 9: No. 1, 85-91(Jan 1974).

Nuclear magnetic resonance techniques were employed to study powder samples of the compounds $NbBe_2$, $NbBe_3$, Nb_2Be_{17}, and $NbBe_{12}$. Nuclear quadrupole coupling constants and Knight shifts were determined for the Nb sites in these compounds. The ^{93}Nb NMR from $NbBe_2$ is a single unsplit line with zero quadrupole coupling constant and a Knight shift of 0.70 ± 0.03%. The ^{93}Nb NMR from a $NbBe_3$ sample shows the presence of three resonance lines having values of e^2qQ/h = 0, 24.2 ± 0.2, 30.1 ± 0.3 MHz and corresponding Knight shifts of 0.69 ± 0.03, 0.72 ± 0.03, 0.53 ± 0.03%. One of these lines was identified as a $NbBe_2$ impurity. The ^{93}Nb NMR of Nb_2Be_{17} exhibits a quadrupole coupling, e^2qQ/h = 5.93 ± 0.15 MHz, and a Knight shift, K_{axial} = 0.014% and $K_{isotropic}$ = 0.34 ± 0.02%. The ^{93}Nb resonance from $NbBe_{12}$ was split by a quadrupole interaction of e^2qQ/h = 21.7 ± 0.3 MHz and a Knight shift of 0.55% ± 0.02%. The beryllium NMR was examined, yielding little information, since no measurable quadrupole interaction or Knight shift was present. (auth)

16268 HEAT CAPACITIES AND RELATED THERMAL PROPERTIES OF $DyNi_5$, $HoNi_5$, and $ErNi_5$ BETWEEN 5 AND 300 K. Sankar, S. G.; Keller, D. A.; Craig, R. S.; Wallace, W. E.; Rao, V. U. S. (Univ. of Pittsburgh). J. Solid State Chem.; 9: No. 1, 78-84(Jan 1974).

Heat capacity data and calculated thermodynamic functions are presented for $DyNi_5$, $HoNi_5$, and $ErNi_5$. λ-type thermal anomalies are noted at 12.0°K ($DyNi_5$), 4.1°K ($HoNi_5$), and 8.0°K ($ErNi_5$). Schottky-type anomalies are observed at higher temperatures. The

λ and Schottky anomalies are ascribed to the destruction of ferromagnetic order and to crystal field excitation, respectively. A deficiency of magnetic entropy, compared to Rln(2J + 1), is noted corresponding roughly to Rln2. This suggests that the ground state in the ordered materials is a doublet. $ErNi_5$ is analyzed using a Hamiltonian containing terms representing the crystal field and magnetic interactions. The analysis shows that doublet ground state can result with reasonable values of the crystal field parameters. The parameters are shown to be consistent with the heat capacity behavior of $ErNi_5$. Ordering temperatures are not proportional to the de Gennes function. (8 tables, 6 figures) (auth)

16269 FREE VOLUME AND SOME THERMODYNAMIC PROPERTIES OF LIQUID METALS. Kononenko, V. I.; Yatsenko, S. P. (Inst. of Chemistry, Sverdlovsk, USSR). High Temp. (USSR) (Engl. Transl.); 10: No. 6, 1095-1097(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 6, 1218-1220 (1972).

The thermodynamic properties of liquid metals are calculated using statistical thermodynamics and the free-volume model. The method is applied to the specific heat of Na, K, Cu, Rb, Cs, Zn, Cd, Hg, Ga, Sn, Pb, Sb, and Bi. (auth)

16270 EFFECT OF HARDENABILITY ON THE Cr–Ni–Mo–V STEEL FRACTURE TOUGHNESS. Kramarov, M. A.; Rybakov, A. B.; Shakhnazarov, Yu. V. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 2, 120-122(1973). (In Russian).

By the method of thermal quenching directly on the metal-shaft intermediate product, the effect of the degree of hardenability on the resistance to fracture spread in Cr–Ni–Mo–V steel was studied. It was established that the hardenability affects the resistance to fracture spread more than other mechanical properties. The possibility of substituting oil for water in the quenching of a shaft of average cross section in order to improve its construction strength was shown. (tr-auth)

16271 EXAMINATION ON MANUFACTURE AND SAFETY OF COLD-PRESS-JOINED ALUMINUM CAPSULES. Ooka, N.; Itami, H.; Nomura, S. (Japan Atomic Energy Research Inst., Oarai). Keikinzoku Yosetsu; No. 116, 337-345(Aug 1972). (In Japanese).

Four kinds of hydraulically press-joined aluminum capsules of 25 mm OD × 114 mm and 21 mm ID, each consisting of a body and a cover, were made, in which (a) 1100 aluminum rod was used for both body and cover, (b) and (c) 1100 rod for the body and 1050 plate for the cover, and (d) 1050 rod for both body and cover. The safety of their use for RI manufacture in nuclear reactors was the object of testing these aluminum capsules formed with press-joining dies under the pressure of 170 to 200 kg/cm² of helium. X-ray radiography was carried out before the safety test with a unit Model RADIO FLEX-100 G-S, 10 to 100 kVp, 5 to 10 mA. The safety test comprises an ethylene glycol leak test under reduced pressure to examine generation of bubbles, drop test from a two-meter height, rupture test by internal pressure, Vicker's hardness test, and observation of macroscopic texture. In conclusion, the x-ray test is an effective method to examine the press-joining condition; all specimens are safe against shock according to the drop test; 60 to 90 kg/cm² of rupture strength can be obtained in the rupture test by internal pressure, when texture orientation of the cover is so arranged as to be normal to that of the body and press-joining is carried out so that deformation is within 65%; and aluminum 1100 is better than 1050 from the standpoint of deformation. (JA)

16272 COMPRESSIBILITY AND THERMAL EXPANSION OF HEAVY RARE EARTH METALS AND ALLOYS. Inoue, C. (Hiroshima Univ.); Kadomatsu, H.; Fujii, H.; Okamoto, T. J. Phys. Soc. Jap.; 35: No. 5, 1322-1327(Nov 1973).

Linear compressibility and the thermal expansion coefficient were measured as a function of temperature on polycrystals of the heavy rare earth metals Gd, Tb, Dy, Ho, and Er and the binary alloys with each other. Anomalous linear compressibility was found near the magnetic transition temperature. The value of the linear compressibility at room temperature monotonically decreased with increasing average number of 4f electrons. The negative δ-type and λ-type anomalies of the thermal expansion coefficient were also found near the ferromagnetic–antiferromagnetic transition temperature and T_c or T_N, respectively. (auth)

16273 INVESTIGATION OF THE SYSTEM Gd–Fe–Al IN THE RANGE OF LOW GADOLINIUM CONTENT. Vivchar, O. I.; Zarechnyuk, O. S.; Ryabov, V. R. (Lvov State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 11, 1040-1042(Nov 1973). (In Ukrainian).

By means of x-ray analysis, the ternary system Gd–Fe–Al was studied in the range of 33.3 at. % Gd. The isothermal section (500°C) is given. In the domain studied, there are three ternary compounds — $GdFe_4Al_8$ (ψ-phase, $ThMn_{12}$ type), $GdFe_{1.6\to1.8}Al_{1.6\to2.2}$, ($\lambda_1$-phase, $MgZn_2$ type), and $GdFe_2Al_{10}$ (ψ'-phase, unknown structure) and four solid solutions based on the binary compounds — $Gd_2Fe_{17.0\to14.5}Al_{0\to2.5}$ × (φ_1-phase, Th_2Ni_{17} type), $Gd_2Fe_{6\to3.0}Al_{0\to0.9}$ (φ_2-phase, Th_2Zn_{17} type), $GdFe_{2.0\to1.7}Al_{0\to0.3}$ and $GdAl_{2.0\to1.33}Fe_{0\to33}$ - $\lambda_{2(Fe)}$ and $\lambda_{2(Al)}$ phases, $MgCu_2$ type). (auth)

16274 ELECTRIC CONDUCTIVITY AND STRUCTURE OF THE VACUUM CONDENSATES OF THE CARBIDES OF TITANIUM, ZIRCONIUM, AND NIOBIUM. Fat'yanov, V. M.; Ushakova, S. E.; Astapchik, S. A.; Sychev, G. T. (Physical-Technical Inst., Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 3, 44-47(1973). (In Russian).

Results of the investigation of the structure and stability of the properties of thin films (1 to 5 μm) of the carbides of Ti, Zr, and Nb in dependence on the condensation temperature are reported. (tr-auth)

16275 STRUCTURE AND PROPERTIES OF MONOCRYSTALS OF W–Re ALLOYS. Savitskii, E. M.; Burkhanov, G. S.; Kuz'mishchev, V. A. pp 16-20 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The effects of the rhenium content on the fine structure of tungsten–rhenium alloy monocrystals were studied. The data obtained were compared with data on polycrystalline tungsten–rhenium alloys and with molybdenum–niobium monocrystalline alloys. The structural effects due to alloying of monocrystals of tungsten with rhenium are explained by an increase in the solubility of the carbide phase and diffusion mobility of carbon. (tr-auth)

16276 CRYSTALLINE AND MAGNETIC STRUCTURES OF MONOCRYSTALS OF RCo_3-TYPE COMPOUNDS. Vetoshkin, I. D.; Kozlov, A. G.; Ovcharov, V. P.; Skokov, A. D. pp 20-26 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Conditions are described for growing monocrystals of intermetallic compounds of cobalt with rare earth metals, of the type RCo_3. The degree of perfection of the crystals obtained was determined by neutron structural analysis. The results of studies on the type of the domain structure on different faces of the crystals and their transformation under the influence of a magnetic field are presented. (tr-auth)

16277 SUBSTRUCTURE OF ORIENTED LARGE-DIAMETER W MONOCRYSTALS OBTAINED BY ZONE ACCRETION. Grishkov, G. N.; Klein, G. A.; Mikhailov, S. M.; Sokolova, V. P. pp 31-36 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

X-ray, microhardness, and microstructural methods were used to study the substructure of 16-mm-dia tungsten monocrystals oriented in the [001], [110], and [111] directions, the crystals having been obtained by zone accretion. It was found that monocrystals in the growing and central parts have the same orientation. In the central parts, the substructure of the monocrystals differs in the equilibrium form with 15′ to 20′ angles of orientation of the unit. In the growing part of the surface the dimensions of the unit are smaller and the angles of orientation are from 5′ to 1°. (tr-auth)

16278 ELECTRON-MICROSCOPE STUDY OF FINE STRUCTURE OF W MONOCRYSTALS PRODUCED BY PLASMA-ARC MELTING. Savitskii, E. M.; Ignatov, D. V.; Kantor, M. M.; Burkhanov, G. S.; Raskatov, N. N.; Naletov, A. M. pp 36-41 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Diffraction electron microscopy was used to study the fine structure of tungsten monocrystals containing 0.005 to 0.008 wt% C, grown using a dropping plasma-arc melt. It was shown that such growing conditions lead to breakdown of the supersaturated solid solution of C in tungsten occurring with a prevalence of homogeneous formation of the separated carbide phase. Dislocations have a very high mobility. This ensures high plastic properties of the tungsten monocrystals studied. (tr-auth)

16279 DISTRIBUTION OF C IN Mo ALLOYED WITH Fe, Ni, AND Pd. Bulgak, L. V.; Belomyttsev, Yu. S.; Nakonechnikov, A. I.; Savitskii, E. M. pp 42-46 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The distribution of carbon in molybdenum alloyed with iron, nickel, and palladium in amounts from 0.1 to 1 wt% was studied by contact autoradiography. The addition of 0.1 wt% of these elements caused an equilibrium distribution in the alloy of 0.05 wt% carbon. When the amount of carbon was more than 0.05 wt%, a second phase formed in the grains. (tr-auth)

16280 EFFECT OF HIGH-TEMPERATURE ANNEALING ON STRUCTURE AND PROPERTIES OF Mo MONOCRYSTALS. Kiseleva, V. N.; Kaverina, S. N.; Shulepov, V. I.; Yudkovskii, S. I.; Yal'tsev, V. N.; Rusakov, A. A.; Matsegorin, I. V. pp 46-52 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo (1973). (In Russian).

By means of electron and optical microscopic methods, measurements of mechanical properties, and x-ray determination of elastic tension, the fine microstructure and properties of molybdenum were studied in the process of prolonged high-temperature annealing. Destruction of the solid solution of interstitial contaminants was demonstrated, accompanied by separation and coagulation of particles of the second phase, forming dislocations. Increase in the annealing time led to increase in the density of the dislocations, transition temperature to the brittle state, and elastic stresses in the metal. (tr-auth)

16281 EFFECT OF TEMPERATURE ON PHYSICO-MECHANICAL PROPERTIES AND STRUCTURE OF ORIENTED W MONOCRYSTALS. Klein, G. A.; Osipova, L. Kh.; Mikhailov, S. M.; Grishkov, G. N.; Volkov, O. V.; Sultanova, M. G. pp 127-132 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The physico-mechanical properties and structure of tungsten monocrystals, oriented in the [110], [111], and [112] directions were studied. The process of destruction of the samples at high temperature differed in different crystallographic directions and densities. (tr-auth)

16282 MECHANISM OF DEFORMATION AND RECRYSTALLIZATION IN CREEP OF Mo MONOCRYSTALS. Zasimchuk, E. E.; Krivenyuk, V. V.; Zholud, V. V. pp 133-139 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Creep was studied in plane monocrystal samples of molybdenum by electron-beam melting at temperatures from 800 to 2000°C and deformation rates of 10^{-1} to 10^{3} % per hour. The directions of extension were ⟨110⟩ and ⟨112⟩. It was found that the creep deformation was determined by the rate of recrystallization, the mechanism of which depends on the test temperature. (tr-auth)

16283 HIGH-TEMPERATURE CREEP IN MONOCRYSTALS OF REFRACTORY METALS. Savitskii, E. M.; Ivanova, V. S.; Shyrev, G. D.; Burkhanov, G. S.; Ermishkin, V. A.; Raskatov, N. N.; Ottenberg, E. V. pp 139-143 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The results of tests on creep in tungsten and molybdenum monocrystals at 1500 and 1700°C are presented. Results of theoretical calculations are compared with experimental data. Besides verification of the current theory, the application of the formula for steady-state creep, proposed by V. S. Ivanova and V. A. Ermishkin, is evaluated. (tr-auth)

16284 CHARACTERISTICS OF PLASTIC DEFORMATION OF SURFACE LAYERS OF Si, Mo, AND Nb MONOCRYSTALS. Shorshorov, M. Kh.; Alekhin, V. P.; Dryunin, S. S.; Shnyrev, G. D.; Merkulov, V. A.; Aliev, G. G.; Smirnov, E. G. pp 144-151 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Metallographic and electron-microscopic studies were made of the effect of small deformations on the distribution of dislocations along the cross section of samples of Si, Mo, and Nb monocrystals in dynamic compression along one principal crystallographic direction. It was found that in a definite degree of deformation, the plastic flow is localized in the thin pre-surface layer of the crystal, as a result of which a higher density of dislocations is formed on the surface. (tr-auth)

16285 EFFECT OF TEMPERATURE ON MECHANICAL PROPERTIES OF Mo MONOCRYSTALS AFTER ZONE MELTING, DEFORMATION, AND ANNEALING. Belomyttsev, Yu. S.; Kapustin, V. D.; Saratovskii, L. N. pp 158-166 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Molybdenum monocrystals with the crystallographic orientations [111], [110], and [100] were obtained by electron-beam zone melting. Changes in the mechanical properties of the crystals were studied upon extension after zone melting, deformation, and recrystallization annealing and compared with polycrystalline molybdenum obtained by arc melting as a function of temperature changes. It was found that the mechanical properties of the monocrystals after zone melting at 20 to 200°C depended on the crystallographic orientation, but at 1400°C, such a dependence was not observed. (tr-auth)

16286 CHANGES IN DISLOCATION OF SUBSTRUCTURES OF Mo MONOCRYSTALS IN ALTERNATE DEFORMATION AND ANNEALING. Dubovitskaya, N. V.; Larikov, L. N.; Yakovenko, Yu. D. pp 167-176 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Diffraction electron microscopy and x-ray methods were used to study the change in dislocation structure of molybdenum monocrystals after alternate rolling deformation at room temperature in the {110} plane, along the ⟨100⟩ direction ($\epsilon \approx 20\%$), and isothermal annealing. It was found that with single deformation to 80% in the {110} plane along the ⟨100⟩ direction the initial orientation of the monocrystal was not maintained. As a result of thermomechanical cyclic processing (total pressing about 80%) the initial orientation of the monocrystal was maintained. (tr-auth)

16287 EFFECT OF DEGREE OF HARDENING ON STRUCTURE OF DEFORMED AND ANNEALED Mo MONOCRYSTALS AND Mo–Re ALLOYS. Zasimchuk, E. E.; Maksimenko, E. A. pp 176-184 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The kinetics of different stages of polygonization of molybdenum monocrystals and molybdenum alloys containing 27 wt% rhenium, deformed by pressing to 10 and 70% at room temperature, were studied by measuring the microhardness of samples annealed for different times at 800°C and the structure of the recrystallized centers. The centers were grown during high-temperature annealing of the deformed monocrystals, as a function of the degree of deformation. (tr-auth)

16288 EFFECT OF THERMAL-CYCLING REGIME ON STABILITY OF MONOCRYSTALS OF W AND W ALLOY CONTAINING 8% Re. Savitskii, E. M.; Burkhanov, G. S.; Kuz'mishchev, V. A. pp 185-191 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The effects of thermocycling on the structural stability of tungsten monocrystals were shown as related to factors such as temperature interval, heating and cooling rates, length of thermocycling, and alloying with rhenium. Basic regularities of changes in substructure of the tungsten monocrystals were demonstrated. The observed effects are related to the role of solubility of carbon and carbide phases in tungsten and to decarbonization of the tungsten monocrystals. (tr-auth)

16289 STUDY OF EMISSION PROPERTIES OF FACES OF W, Mo, AND Ta MONOCRYSTALS BY THERMOELECTRON EMISSION AND SURFACE IONIZATION OF Na AND Li. Zhanabergenov, K. Zh.; Imangulova, G. N.; Sytaya, E. P. pp 207-211 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The behavior of sodium and lithium atoms on densely packed (110) and porous (111) faces of tungsten, molybdenum, and tantalum monocrystals was studied by a combination of thermoelectron emission and positive surface ionization. It was found that, on the porous faces, the initial adsorption of sodium and lithium resulted in an increase in the escape energy, which decreased upon further adsorption. On the dense faces (110), with any coating of sodium or lithium atoms, the escape energy decreased. (tr-auth)

16290 MAGNETIC SUSCEPTIBILITY OF MONOCRYSTALS OF ALLOYS OF Ta–W AND W–Re SYSTEMS. Savitskii, R. M.; Bykov, V. N.; Budagovskii, S. S.; Burov, I. V.; Pirogova, S. V.; Prokhorov, I. A. pp 229-235 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The magnetic susceptibility of solid-solution monocrystals of rhenium in tungsten (up to 26 wt%) and in tantalum–tungsten alloys in all concentration intervals was determined at room temperature. In solid solutions of these alloys the zone energy spectrum changed in accordance with a model of a rigid band. During the alloying, processes related to change in the spatial distribution of valence electrons occurred. (tr-auth)

16291 THERMOELECTRIC PROPERTIES OF Mo MONOCRYSTALS. Savitskii, E. M.; Kuritnyk, I. P.; Stadnyk, B. I.; Ottenberg, E. V.; Burkhanov, G. S. pp 235-241 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Molybdenum monocrystals grown by electron-beam zone melting were found to have better reproducibility and evaporation stability characteristics than polycrystals. (tr-auth)

16292 STABILITY OF ELECTROPHYSICAL PROPERTIES OF Nb MONOCRYSTALS AT HIGH TEMPERATURES. Savitskii, E. M.; Kuritnyk, I. P.; Stadnyk, B. I.; Lakh, V. I. pp 241-247 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov.

Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

A correlation was established between the thermoelectromotive force, the residual electrical resistance at the temperature of liquid nitrogen, the microhardness of niobium monocrystals, and the oxygen, hydrogen, and carbon contents. Changes in these properties as a result of heating at 1400 to 2000°C in a vacuum of 10^{-4} mm Hg were studied. (tr-auth)

16293 MECHANICAL PROPERTIES OF Mo–W ALLOYS. Ababkov, V. T.; Morgunova, N. N. (Central Scientific Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 5-6, 376-378(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 5, 16-18(May 1973).

The mechanical properties of Mo–W alloys containing 0 to 100% W at 20 to 2000°C were studied. It was found that the strength of Mo–W alloys at low (20 to 600°C) and high (over 1800°C) temperatures increases with the tungsten content, and at moderate temperatures (600 to 1800°C) the strength is highest for alloys with the maximum alloying. At 1500 to 1800° the strength-to-weight ratio is highest for molybdenum alloys with 80, 56, and 32.5% W, and is equal to or larger than that of unalloyed tungsten. The strength of Mo–W alloys can be increased substantially by small additions of titanium and zirconium. (JRD)

16294 STRUCTURE AND PHASE COMPOSITION OF WELDMENTS IN Zr–2.5Nb ALLOY. Lupakov, I. S.; Rodchenkov, B. S.; Vukolova, V. N.; Tyurin, V. N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 5-6, 379-381(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 5, 19-21(May 1973).

The structure in the weld seams, heat affected zones, and base metals was investigated. It was found that the structure and phase composition of the heat-affected zone and the weld seam of electron-beam weldments in a zirconium alloy with 2.5% Nb are different from those in the base metal and result from quenching of the alloy from the β and $\alpha + \beta$ regions that occurs in the process of welding. Annealing causes equalization of the phase composition in all areas of the weld. The annealing time required is ≥ 28 h at 550, ≥ 10 h at 590, and ≥ 1 h at 700°C. (JRD)

16295 EFFECT OF TEMPERATURE ON THE EFFECTIVENESS OF HARDENING OF HEAT-RESISTANT ALLOYS. Poloskin, Yu. V.; Makarovskii, N. L. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 5-6, 418-420(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 5, 56-59(May 1973).

The samples were tested in a two-chamber furnace at 500 to 900°C. Results of the fatigue tests of alloys KhN77TYuR and EI929 showed that the effectiveness of surface hardening by plastic deformation decreases with increasing testing temperatures, and at 900°C the fatigue limit is the same in both cases. The decreasing hardening effect at high temperatures results from relaxation of the favorable compressive stresses and changes in the surface layer. (auth)

16296 HEAT RESISTANCE OF Cr–Ni AND Cr–Ni–Mo STEELS WITH BORON ADDITIONS. Morozov, Yu. A.; Sidel'kovskii, M. P.; Rozenberg, V. M. (Scientific-Research Inst. of Heavy Machine Construction, Volgograd, USSR). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 5-6, 447-450(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 6, 2-4(Jun 1973).

The effects of small B additions (< 0.005%) on Cr–Ni and Cr–Ni–Mo steels were investigated. It was found that at temperatures below the equicohesive temperature, i.e., with transcrystalline fracture, the long-term strength of Cr–Ni and Cr–Ni–Mo steels increases continuously with increasing boron additions up to 0.005%. At temperatures above the equicohesive temperature, where fracture is intergranular, the long-term strength of the steels is highest at boron concentrations of 0.001 to 0.0018%. It was established that small boron additions increase the strength of the grain boundaries, which is manifest at temperatures above the equicohesive temperature; small boron additions slow down the diffusion processes of precipitation of excess phases in the boundaries and within the grains during creep; and additional strengthening of the grain boundaries evidently occurs at concentrations of 0.004 to 0.005% B due to precipitation of dispersed borides. (JRD)

16297 GLIDE SYSTEMS AND PEIERLS STRESSES IN HCP METALS FROM PHONON ENERGIES. Boffi, S. (Univ., Pavia, Italy); Caglioti, G. Energ. Nucl. (Milan); 20: No. 11, 622-626 (Nov 1973).

The Peierls energy and Peierls stress are computed for the basal and prismatic glide systems of zirconium and other hcp metals (Cd, Zn, Mg, Co, Tl, Be). A lattice dynamics approach is used and results are compared with continuum theory predictions and experimental findings. In agreement with the experiment, the lattice dynamics estimate confirms that for zirconium the above glide systems should be almost competitive, the prismatic one being only slightly preferred; furthermore, against the predictions of continuum theory, the lattice dynamics approach allows to puzzle out the unsuccessfully debated problem of the preferred prismatic glide system of magnesium: the latter turns out to be controlled by the shape of the dispersion curves of the normal modes of vibration of this crystal rather than by the generally more relevant c|a ratio. With the exception of beryllium, where the continuum theory fails and the present lattice dynamics formulation (limited to the first nearest-neighbor interplanar force constants) seems to be inadequate to this specific case, the slip behavior of all the hcp metals considered is in qualitative agreement with the experiment. (4 tables) (auth)

16298 MAGNETIC BEHAVIOR OF HETEROGENEOUS ALLOYS: $R_5Co_{19} + RCo_5$ (R = Ce, Ce–La, CeMM). Feldmann, D.; Khan, Y. (Univ., Bochum, Ger.). Appl. Phys.; 2: No. 4, 177-182(1973). (In German).

Magnetic and mechanical properties of the new phase R_5Co_{19} in the Ce–Co, Ce–La–Co, and CeMM–Co systems were investigated. The effect of this phase on the magnetic properties of RCo_5 alloys (R = Ce, CeLa, and CeMM) and the influence of the variation in composition of commercial CeMM on the magnetic properties of $CeMMCo_5$ are presented. The x-ray diffraction analysis was carried out by means of a Philips powder diffractometer and an Enraf–Nonius–Guinier camera. For the metallographic studies and the visualization of the magnetic domains by the Kerr effect, a Leitz orthoplane polarization microscope with microhardness testing device was used. The magnetic measurements were done using a vibrational magnetometer (model 155) of the firm PAR and the Curie temperatures have been determined from $M^2(T)$ curves taken at H(a) = 500 Oe. The lattice parameters were derived using Si-calibrated Guinier pictures. (GE)

16299 STUDY OF THE PROCESSES OF SOFTENING DURING CREEP OF MOLYBDENUM AND ITS ALLOYS. Marusiy, O. I.; Zasimchuk, E. E. Probl. Prochnosti; No. 8, 34-37(Aug 1973). (In Russian).

Structural changes during creep of industrial molybdenum, annealed before testing at temperatures over 1200°C, and its alloys with titanium and zirconium are studied. It is established that the acceleration of deformation (onset of the third stage of creep) is related to recrystallization of local areas of the material tested. Recrystallization during the creep process is stimulated by deformation and is not related to the initial structure of the molybdenum and its alloys. The mechanism of formation of recrystallization zones in the materials with developed substructure is studied. (5 figures, 10 references) (JPRS)

16300 EFFECT OF ADSORPTION ON THE ELECTRICAL CONDUCTIVITY OF THIN VANADIUM FILMS. Lakh, I. I.; Stasiuk, Z. V. (Lvov State Univ.). Fiz. Elektron.; No. 5, 102-104(1972). (In Russian).

The effect of adsorbed barium on the electrical conductivity and work function is investigated in vanadium films prepared by vaporized vanadium deposition in ultrahigh vacuum. Barium adsorption is found to appreciably change the conductivity only in granular vanadium films. (IAA)

16301 DISLOCATIONS AND TWINNING IN INDIUM. Van der Biest, O. O. (Univ. of California, Berkeley); Van der Planken, J. Scr. Met.; 7: No. 12, 1279-1286(Dec 1973).

The mechanisms of slip dislocation interactions with twinning were studied. It was found that glide dislocations remain glissile when twinning takes place in indium. Dislocation reactions taking place at twin boundaries are proposed that allow glide dislocations to penetrate twins. The change in elastic energy for these reactions is not a prohibitive factor, in contrast to reactions proposed for other structures e.g., bcc. Metallographic observations are presented to support these theoretical results. (JRD)

16302 THEORETICAL APPROACHES TO THE DETERMINATION OF PHASE DIAGRAMS. Kaufman, L.; Nesor, H. (ManLabs, Inc., Cambridge, MA). Annu. Rev. Mater. Sci.; 3: 1-30(1973).

Information concerning development of methods used in preparing phase diagrams is presented. Examples are included on phase-diagram calculations based on thermochemical data. (148 references) (JRD)

16303 HIGH-TEMPERATURE COMPOUNDS. Nowotny, H.; Windisch, S. (Univ., Vienna). Annu. Rev. Mater. Sci.; 3: 171-194(1973).

Properties of high-temperature solid compounds are examined. Information and discussions are included on occurrence of high-

temperature compounds, theory of bonding, nonstoichiometry, and nonmetallic and metallic high-temperature compounds. (132 references) (JRD)

16304 ω-PHASE AS AN EXAMPLE OF AN UNUSUAL SHEAR TRANSFORMATION. Williams, J. D. (Rockwell International, Thousand Oaks, CA); de Fontaine, D.; Paton, N. E. Met. Trans.; 4: No. 12, 2701-2708(Dec 1972).

The conditions leading to formation of the metastable ω-phase in Ti, Zr, and Hf alloys are described, and earlier experimental observations directly related to ω-phase formation are summarized. New experimental results are presented which show that increased oxygen content suppresses athermal ω-phase formation in Ti–V alloys. A mechanism of ω-phase formation based on the formation of a linear displacement defect is described, and it is shown that both the earlier and new experimental results are consistent with this mechanism. Additional experimental results on variations in electrical and physical properties in Ti alloys are also shown to be consistent with the linear-displacement-defect model. (28 references) (auth)

16305 TRANSFORMATION IN RARE EARTH METALS. Altstetter, C. J. (Univ. of Illinois, Urbana). Met. Trans.; 4: No. 12, 2723-2730(Dec 1973).

The crystal structures of rare-earth metals and intrarare-earth alloys are described, and studies of the phase transformations in these metals are surveyed. Comparison is made with similar transformations in other alloy systems. Knowledge of the thermodynamics, kinetics, and mechanisms of transformations in the rare earths is assessed, and directions for future work are suggested. (48 references) (auth)

16306 PHASE TRANSFORMATIONS IN URANIUM, PLUTONIUM, AND NEPTUNIUM. Rechtien, J. J. (Argonne National Lab., IL); Nelson, R. D. Met. Trans.; 4: No. 12, 2755-2765 (Dec 1973).

The actinide metals uranium and neptunium are characterized by three allotropes, and plutonium has six solid phases with two of the allotropes having complex, low-symmetry, crystal structures. Further, many phase changes in these metals are accompanied by a large specific volume change and a large enthalpy change. Phase transformations in uranium and plutonium have been studied extensively, but very little experimental work has been conducted to understand the phase transformations in neptunium. The low-temperature transformations occur isothermally and exhibit simple TTT curves similar to many alloys. The kinetics in the metals are controlled more by purity and thermal history than by any inherent feature of the metals. Mechanisms in the pure metals are inadequately understood, and the crystallographic relations are complex. The $\beta \rightarrow \alpha$ transformations in uranium and plutonium are diffusional near the $\alpha \rightleftarrows \beta$ equilibrium temperature, and they are both reminiscent of shear transformations at low temperatures. Skip transformations have been studied in these metals, and the role of grain size on transformation behavior has been investigated more than in other metals. Accordingly, the roles of metal purity, thermal history, microstructure, mechanical properties, and thermodynamic variables are discussed, particularly as they might be related to phase transformations in other systems. Generalities have been difficult to establish for plutonium and uranium alloys. Among well-known metals, the zirconium and titanium transformations form the closest analogs to the uranium transformations, but there is no obvious analog to the plutonium transformations. (97 references) (auth)

16307 PHASE TRANSFORMATION IN LESS COMMON MATERIALS. Wayman, C. M. (Univ. of Illinois, Urbana). Met. Trans.; 4: No. 12, 2781-2787(Dec 1973).

Recent years have encompassed the investigation of phase transformations in a wider variety of materials. Such investigations have raised a number of questions. In many cases "less common" materials have been studied in an attempt to more fully characterize them, certain specific advantages and applications having already been recognized (e.g., uranium and its alloys). Generally the transformations in these more complex materials have been analyzed and compared with "reference" results obtained from the study of simpler systems. Nevertheless, recent investigations of transformations in both common and uncommon systems lead to a number of interesting topics for discussion, such as pretransformation phenomena, nucleation and the role of phonons, a comparison of the martensitic and omega types of transformations, reversible transformations and "shape memory" mechanical behavior, atom shuffles, new types of ordering reactions, and certain effects exhibited by polymers, oxides, lanthanides, and actinides. (42 references) (auth)

16308 EFFECT OF OXIDE DISPERSIONS ON RECRYSTALLIZATION OF BERYLLIUM. Webster, D. (Lockheed Missiles and Space Co., Palo Alto, CA); Crooks, D. D.; Vidoz, A. E. Met. Trans.; 4: No. 12, 2841-2847(Dec 1973).

The recrystallization behavior of beryllium containing fine BeO dispersions has been studied by following the changes of hardness during annealing and the modifications of the microstructure by optical and transmission electron microscopy. It was found that, for equal concentrations of BeO, the recrystallization temperature was dependent upon the size of the dispersoid, being higher the finer the median particle size of the oxide. In an alloy with a median particle size of 600Å, a dislocation substructure was maintained up to very near the melting point of beryllium. (auth)

16309 NEW INTERMETALLIC PHASE IN THE NICKEL–TUNGSTEN SYSTEM. Walsh, J. M.; Donachie, M. J. Jr. (Pratt and Whitney Aircraft, East Hartford, CT). Met. Trans.; 4: No. 12, 2854-2856(Dec 1973).

During an interdiffusion study in the Ni–W system several diffusion couples were examined that contained a previously unreported intermetallic NiW phase. Diffraction pattern data obtained on the phase are tabulated. It appears that the NiW phase forms by a peritectoid transformation between 1038 and 1093°C. A proposed phase diagram is included. (JRD)

16310 HEATS OF MIXING IN LIQUID SOLUTIONS OF GROUP V ELEMENTS IN INDIUM AND GALLIUM. Rao, M. V. (Stanford Univ., CA). Scr. Met.; 7: No. 11, 1165-1170(Nov 1973).

Data and information are presented that are used to demonstrate linear correlations between the maximum heats of mixing in liquid solutions of Bi, Sb, and As in In and Ga, respectively. Where experimental heats of mixing are not available, they are calculated at the stoichiometric compound compositions using other enthalpy data and a heat balance equation. Using the correlations, heats in the Ga–P and In–P systems are estimated. The enthalpy balance equation, derived using what is commonly known as Hess' Law of Heat Summation, provides a means for estimating one quantity when the others are known. The equation is concisely derived. (JRD)

16311 SOLUTE SEGREGATION STRESSES AROUND VOID SURFACES. Nolfi, F. V. Jr. (Argonne National Lab., IL). Scr. Met.; 7: No. 11, 1181-1188(Nov 1973).

The distribution of stresses in cases of solute–solvent concentration misfits near growing voids was studied as related to solute abundance profiles. It was found that in finite solids containing N widely spaced, uniformly distributed inclusions, centrally located inclusions have spherically symmetric stress and displacement fields within a few radii (R) of their centers. The image contribution to these fields is N times that computed for a single inclusion in a solid of the same external dimensions. The remaining contribution to the stress and displacement fields is the same as calculated for a single inclusion in an infinite solid. The study is related to irradiated metals and alloys. (JRD)

16312 SOLID-SOLUTION SOFTENING AND HARDENING. Gibala, R.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). Scr. Met.; 7: No. 11, 1143-1148(Nov 1973).

The bases for models of solid-solution softening and hardening are discussed. Conclusions of these discussions are presented which show that most intrinsic mechanisms cannot be applied to solution softening in Ta and Nb alloys. Scavenging-like mechanisms, related to effects that solute interactions have on the strain center density, strength or distribution in materials which are effectively ternary alloys, offer the only realistic explanation of solution softening in Ta and Nb alloys. In other materials, the evidence is not all in, because the systematic experiments with respect to purity and secondary solute additions done on Ta and Nb alloys have not been performed. The results of a few investigations on other metals to date, the generality of behavior demanded of all metals by "intrinsic" theories of solution softening and the obvious exceptions to this behavior by Ta and Nb, all strongly suggest that if a single mechanism of solute softening exists, it must be a scavenging/solute interaction mechanism. (JRD)

16313 STRENGTH DIFFERENTIAL IN SOME TITANIUM ALLOYS. Winstone, M. R.; Wright, M. L.; Rawlings, R. D. (Imperial Coll. of Science and Tech., London). Scr. Met.; 7: No. 12, 1265-1268(Dec 1973).

The effects of heat treatments on the flow stress factors in Ti base–5% Al–$2\frac{1}{2}$% Sn and in Ti base–6% Al–4% V alloys were investigated. The difference in behavior found between the Sn containing and V containing alloys is attributed to the interaction between interstitial impurity atoms, substitutional atoms, and dislocations. Data on stress–strain, strength differentials, and crystal structure are included. (JRD)

16314 STRENGTH OF SOLDERED JOINTS OF MOLYBDENUM SHEET. Osintsev, C. E.; Bareskov, N. A.; Morgunova, N. N.;

Lebedeva, Z. M.; Vorontsova, T. V. Svar. Proizv.; No. 3, 37-39 (Mar 1973). (In Russian).

The low strength of soldered joints, working under tension, is connected with the extremely low strength of Mo alloys in thin sheets. The strength of thin sheets of Mo alloys can be increased by recrystallization of the deformed metal, by reduction of the degree of deformation during cold rolling, and by rolling at temperatures higher than the recrystallization temperature. In the soldered joints under tensile stress perpendicular to the strength of the sheet it is advisable to use recrystallized Mo alloys. (tr-auth)

16315 ORDER-DISORDER TRANSFORMATIONS OF INTERSTITIAL SOLUTES IN TRANSITION METALS OF IV AND V GROUPS. Hirabayashi, M.; Yamaguchi, S.; Asano, H.; Hiraga, K. (Tohoku Univ., Sendai). (1973). vp.

From international symposium on order-disorder transformation in alloys; Tuebingen, Ger. (3 Sep 1973).

A survey is presented of the order-disorder transformations in the interstitial alloys of transition metals with hydrogen, deuterium, and oxygen. Special attention is given to the formation of interstitial superstructures, stepwise processes of disordering and property changes attributed to order-disorder. Four groups of interstitial alloys are considered: (1) Ti-O, Zr-O, Hf-O, (2) V-O, (3) V-H, V-D and (4) Ta-H, Ta-D. Characteristic features of the phase transformations in each group and each system are presented and discussed in comparison with others. (GE)

16316 PROBLEM OF THE VARIATION OF YOUNG'S MODULUS OF Fe-Cr, Fe-Mo, AND Fe-W ALLOYS. Drapkin, B. M. (Rybinsk Technological Inst., USSR). Probl. Prochnosti; 5: 78-79(Apr 1973). (In Russian).

The Young's modulus was measured in alloys of iron with chromium, molybdenum, and tungsten at temperatures from 20 to 500°C. The concentration dependence of the Young's modulus exhibits a maximum at relatively low contents of the alloying element in all three systems, and the general appearance of this concentration dependence remains unaffected by increasing temperature. This is explained by the competing effects of the scale factor and of chemical interaction between atoms of the base and alloying elements. (IAA)

16317 THERMODYNAMIC PROPERTIES OF THE LAVES PHASE. Rezukhina, T. N.; Kravchenko, L. I.; Pokarev, B. S. (Moscow State Univ.). Metallofizika; No. 46, 21-28(1973). (In Russian).

A survey is given of methods of thermodynamic investigation and thermodynamic properties of the Laves phase of intermetallic compounds, crystallized in lattices of the C15, C14, and C36 type. In the case of Laves phase containing metals of the platinum group (and rhenium) and chemically active metals such as Th, Y, Sc, and alkaline earth and rare earth metals, the most feasible is the emf method with solid CaF_2. This method was used for the determination of the thermodynamic properties of the Laves phase of $ThRe_2$, YRe_2, $BaPt_2$, $CeIr_2$, and $LaIr_2$ at 1000 to 1200°K. Data for the last three phases was published for the first time. (tr-auth)

16318 X-RAY STRUCTURAL STUDY OF THE ELECTRONIC STRUCTURE OF THE LAVES PHASE OF $NbCr_2$ AND $NbCo_2$. Nemoshkalenko, V. V.; Nesenyuk, A. P.; Krivitskii, V. P.; Mamko, B. P.; Nagornyi, V. Ya.; Nikolaev, L. I.; Shpak, A. P. (Inst. of Metal Physics, Kiev). Metallofizika; No. 46, 32-35(1973). (In Russian).

The x-ray emission L and M spectra of Nb and the K and L spectra of Cr and Co from the Laves phase of $NbCr_2$ and $NbCo_2$ with lattice of the $MgCu_2$ type were studied. Parameters of the emission band were obtained: relative integral and peak intensities, widths, and mixing. Results were qualitatively fit into the framework of the model of binary alloys or compounds. It was concluded that the formation of the $NbCr_2$ and $NbCo_2$ phase leads to a substantial change of the energy distribution of the occupied states of the p and d symmetries in the vicinity of the atoms of Nb, Cr, and Co in comparison with that of the pure metals, but the character of the interatomic bonds is practically the same as in original pure metals. (tr-auth)

16319 LAVES PHASES IN SYSTEMS OF TRANSITION METALS OF THE IV-VIII GROUPS OF THE PERIODIC SYSTEM. Svechnikov, V. N.; Kocherzhinskii, Yu. A.; Markiv, V. Ya.; Pet'kov, V. V. (Inst. of Metal Physics, Kiev). Metallofizika; No. 46, 35-45(1973). (In Russian).

With use of x-ray (at room and elevated temperatures), differential thermal, microstructural, and durometric methods of analysis, a systematic investigation was made of the phase structure of alloys near the composition RX_2 where R is Ti, Zr, Hf, Nb, and Ta and X is V, Cr, Mn, Fe, Co, Ni, Mo, W, and Re. The regularities in the formation of different types of the Laves phase (λ_1, λ_2, λ_3) were thoroughly analyzed in dependence on the position in the periodic system of the components forming them. (tr-auth)

16320 LAVES PHASES IN TERNARY SYSTEMS FORMED BY ZIRCONIUM WITH TRANSITION METALS OF THE V-VII GROUPS OF THE PERIODIC SYSTEM. Prima, S. B.; Tret'yachenko, L. A.; Eremenko, V. N. (Inst. of Problems in Materials Science, Kiev). Metallofizika; No. 46, 45-51(1973). (In Russian).

The regularities in the replacement of the structural types of the Laves phases formed by Zr with the transition metals of the V-VII groups were examined in accordance with the position of the B component in the periodic system. The characteristics of the interaction of the AB_2 phase in the ternary system $Zr-Me^{V-VII}-Me^{V-VII}$ were examined. It was shown that the phase diagrams of the ternary systems of Zr with the transition metals of the V-VI groups and Mn from the VII group can be assigned to five different types according to the character of the phase. (tr-auth)

16321 EVALUATION OF THE INTERATOMIC INTERACTIONS IN SOME LAVES PHASES. Alisova, S. P.; Budberg, P. B. (Inst. of Metallurgy, Moscow). Metallofizika; No. 46, 67-72(1973). (In Russian).

Polarization of the component atoms in Laves phases, formed by metals of the IVA and VA groups with Cr and Fe ($TiCr_2$, $ZrCr_2$, $NbCr_2$, $TiFe_2$, and $ZrFe_2$) was examined. Comparison of the Ti, Zr, and Nb alloys hardened by the Laves phase (investigation of the profiles along a metal-Laves phase cross section in the corresponding ternary systems) with evaluation of the interatomic interactions in the compounds made it possible to indicate the increase of the fragility threshold in alloys containing phases where Fe is the B component. (tr-auth)

16322 PHASE EQUILIBRIUM AND CRYSTAL STRUCTURE OF THE INTERMEDIATE PHASE IN THE Ta-Cr SYSTEM. Kocherzhinskii, Yu. A.; Pet'kov, V. V.; Shishkin, E. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 46, 75-80(1973). (In Russian).

The Laves phases were investigated and the phase equilibrium in the Ta-Cr system was established by x-ray structural, differential thermal, local x-ray spectral, and microstructure analysis methods and by measurement of the microhardness. Identification was made of the Laves phase by means of the calculation of the intensity of the lines and comparison of these lines with those observed in the x-ray diagrams. New data on the metallides in the Ta-Cr system were shown on the phase diagram. (tr-auth)

16323 NEW DATA ON LAVES PHASES IN THE Zr-Cr SYSTEM. Pet'kov, V. V.; Prima, S. B.; Tret'yachenko, L. A.; Kocherzhinskii, Yu. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 46, 80-84(1973). (In Russian).

By x-ray, differential thermal, and microstructure analysis methods, alloys of the Zr-Cr system were investigated in the concentration interval from 27.8 to 80.5 at. % Cr. A modification of the compound $ZrCr_2$ (λ_3 phase) was observed with $MgNi_2$-type structure and with lattice constants a = 5.100 Å and c = 16.61 Å. It was shown that during heating of the alloy in the stoichiometric composition, transitions occurred according to the scheme $\lambda_3 \xrightarrow{1560°C} \lambda_3 \xrightarrow{1620°C} \lambda_1 \xrightarrow{1670°C}$ fusion. Part of the phase diagram of the Zr-Cr system near the $ZrCr_2$ composition was constructed. (tr-auth)

16324 LAVES PHASE IN THE Hf-Mo BINARY SYSTEM. Eremenko, V. N.; Velikanova, T. Ya.; Kocherzhinskii, Yu. A.; Shabanova, S. V.; Shishkin, E. A.; Pet'kov, V. V. (Inst. of Metal Physics, Kiev). Metallofizika; No. 46, 84-87(1973). (In Russian).

By x-ray graphic, metallographic, and differential thermal analysis methods and by determination of the fusion temperature of the alloys, the structure of alloys of the Hf-Mo binary system was investigated in the region of existence of the Laves phases above 2040 ± 20°C. It was shown that the compound $HfMo_2$ is polymorphic. The temperature for the transition of the high-temperature hexagonal modification of the $MgNi_2$ type to the low-temperature cubic $MgCu_2$ type depends on the composition and equals 1860°C in the ($HfMo_2$ + Mo) region and 1780°C in the ($HfMo_2$ + Hf) region. The region for the homogeneity of the Laves phases (60 to 65 at. % Mo) was displaced from the stoichiometric composition to the Hf side. (tr-auth)

16325 PHASE EQUILIBRIA IN THE W-Cr-Zr SYSTEM AT 1200 AND 1500°C. Sukhaya, S. A.; Tret'yachenko, L. A.; Eremenko, V. N. (Inst. of Problems of Material Management, Kiev). Metallofizika; No. 46, 88-89(1973). (In Russian).

By metallographic and x-ray analyses and determination of the fusion temperature, it was shown that in the ternary system W-Cr-Zr at 1200 and 1500°C a continuous series of solid solutions are formed between the intermetallides ZrW_2 and $ZrCr_2$ with a cubic structure of the $MgCu_2$ type. In the ternary system a region of dissociation of the W- and Cr-based solid solutions in which W- and Cr-based solid solution and intermetallic phase coexist. This region narrows during temperature increase. (tr-auth)

16326 INVESTIGATION OF ALLOYS OF THE Mo-V-Zr TERNARY SYSTEM THROUGH THE $ZrMo_2$-ZrV_2 CROSS SEC-

TION. Eremenko, V. N.; Tret'yachenko, V. N.; Gusarenko, L. A. (Inst. of Problems of Material Management, Kiev). Metallofizika; No. 46, 90-92(1973). (In Russian).

By metallographic and x-ray graphic investigation of cast and annealed alloys of $ZrMo_2$–ZrV_2, determination of the solidus temperature, and measurement of the microhardness, it was shown that in the Mo–V–Zr ternary system a continuous series of solid solution having a cubic structure of the $MgCu_2$ type (λ_3) are formed between the Laves phases of $ZrMo_2$ and ZrV_2. (tr-auth)

16327 LAVES PHASES IN TERNARY SYSTEMS RARE EARTH METALS–TRANSITION METALS OF THE IV PERIOD–ALUMINUM. Zarechnyuk, O. S.; Rykhal, R. M.; Vivchar, O. I. (L'vov State Univ.). Metallofizika; No. 46, 92-94(1973). (In Russian).

By x-ray structural methods, alloys of the ternary system R–T–Al were investigated along the quasibinary cross section RAl_2–RT_2, where R is the rare earth metals and T is the transition metals of the IV period. A series of new ternary Laves phases were established with structures of the $MgZn_2$ type: RFeAL (R = Sc, Y, Sm, Gd, Tb, Dy, Ho, Er, and Tm), YCoAl, and $YNi_{1.5}Al_{0.5}$. On the basis of the results and literature data, conclusions are drawn on the conditions for the formation of ternary Laves phases in the R–T–Al system. (tr-auth)

16328 LAVES PHASES CONTAINING RARE EARTH METALS. Bodak, O. I.; Gladyshevskii, E. I.; Koshel, O. S.; Kharchenko, O. I. (Lvov State Univ.). Metallofizika; No. 46, 94-99(1973). (In Russian).

Literature data on the compound composition RX_2 and their structures, formed in the binary system of rare earth metals with the transition metals of the IV–VI periods and with metals of the Cu and Zn subgroup, were examined. 238 RX_2 compounds were found which belong to the structural types of $MgZn_2$, $MgCu_2$, $MgNi_2$, AlB_2, $CeCu_2$, $CeCd_2$, and $MoSi_2$. The selection of the structural type is connected with the ratios of the atomic dimensions. 22 continuous series of solid solutions of the $R(X,X')_2$ and $(R,R')_2X$ type, having Laves phase structures, were described. Experimental data were obtained on the solid solutions $Y(Fe,Co)_2$, $(Y,Sm)Fe_2$, $(Y,Sm)Co_2$, and $(Y,Sm)Ni_2$. (3 tables, 4 figures, 33 references) (tr-auth)

16329 HEAT RESISTANCE OF SOME LAVES PHASES. Gaidarenko, A. L.; Sivakova, E. V.; Pet'kov, V. V. (Inst. of Metal Physics, Kiev). Metallofizika; No. 46, 100-103(1973). (In Russian).

Results of studies on the resistance to heat of some Laves phases in HfV_2, $ZrMo_2$, $HfMo_2$, HfW_2, and $TaCr_2$ are reported. The Laves phases of $ZrMo_2$, HfW_2, and $HfMo_2$ have satisfactory heat resistances up to temperatures of 800 to 850°C. The highest level of heat resistance was detected in $TaCr_2$, which is practically unoxidized in air in the temperature interval from 20 to 1500°C. The heat resistance of $TaCr_2$ is guaranteed because of the surface formation of protective films, the basic phase component of which is the η phase (structure of the Ti_2Ni type with face-centered cubic lattice with lattice constant a = 11.43 Å) with the tentative composition Ta_3Cr_3 (O,N). (tr-auth)

16330 X-RAY INVESTIGATION OF ALLOYS OF IRON WITH ZIRCONIUM, ENRICHED WITH IRON (Fe–$ZrFe_2$). Guseva, L. N.; Malakhova, T. O. (Inst. of Metallurgy, Moscow). Metallofizika; No. 46, 111-113(1973). (In Russian).

In addition to γ phases with composition $ZrFe_2$ attributed to the cubic Laves phase of the $MgCu_2$ type and η phases with a composition close to $ZrFe_2$ with cubic structure of the Th_6Mn_{23} type, there is a second Laves phase with composition $(Zr_{0.8}Fe_{0.2})Fe_2$ with hexagonal structure of the $MgZn_2$ type. A different valency of the Fe atom occurring in the A and B positions of this structure was assumed. (tr-auth)

16331 ORDER–DISORDER TRANSFORMATION IN Au_4V. (1973). vp.

From international symposium on order–disorder transformation in alloys; Tuebingen, Ger. (3 Sep 1973).

An interesting and very pronounced effect of local atomic arrangement on the physical properties was observed in the Au–V system. Au_4V, as a concentrated alloy of a 3d metal, undergoes the order–disorder transformation below 565°C and exhibits there a marked change in the electric, magnetic and mechanical behavior. To get some insight into the ordering kinetics, a series of electrical resistivity experiments has been made and a correlation of the ordering kinetics with some of the physical properties of the alloy (electrical resistivity, its temperature coefficient, microhardness, paramagnetic susceptibility, and the integrated x-ray intensity of the resolved superlattice lines) has been given. (GE)

16332 INTERNAL FRICTION STUDY OF GOLD SINGLE CRYSTALS IN THE MEGACYCLE RANGE. Akune, K. (Univ., Lausanne, Switzerland); Vittoz, B.; Mondino, M. (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Gold single crystals with the three orientations ⟨100⟩, ⟨110⟩, ⟨111⟩ and of 99.999% purity were prepared. After having undergone low-range deformation by compression at room temperature, and neutron irradiation in water (integrated flux = 10^{14} or 10^{15} nvt), the specimens were annealed for 1 hour at increasing temperatures up to 500°C. The internal friction was determined as function of annealing temperature from the measurement of ultrasonic attenuation at room temperature in the frequency range of 5 to 150 MHz. The orientation dependences and the influence of impurities as well as irradiation effects were studied. The observed internal friction–frequency relations are well represented by the theoretical curve of the Granato–Luecke model, which allows calculation of the density, and the average length of dislocations. (GE)

16333 INTERSTITIAL RELAXATIONS DUE TO HYDROSTATIC STRESS IN NIOBIUM–OXYGEN ALLOYS. Tewari, S. N.; Cost, J. R. (Purdue Univ., Lafayette, IN). (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Isothermal measurements at 81.6°C of an anelastic relaxation induced by hydrostatic stresses in the range from ambient to 80.0 psi have been made for a Nb–2.3 at. % O system. Analysis of the relaxation is made by considering the relaxation spectrum as composed of three discrete relaxation times and as a lognormal distribution about some mean relaxation time. The relaxation which occurs during pressurization is considered to be due to the reaction of single interstitial oxygen atoms to form oxygen doublets (or higher order multiplets). The reverse reaction is considered to occur during pressure release. The relaxation strength and rate are found to be in good agreement with predictions based upon the above model for the reaction. The pressure dependence of the relaxation rate gives an apparent activation volume of 4 cm^3/mole. (GE)

16334 STUDY OF Zr–Mo–Cu ALLOY. Zapletalek, A. (Welding Research Inst., Bratislava). Hutn. Listy; 27: No. 9, 651-657(Sep 1972). (In Czech).

Properties were investigated of a series of Zr–Mo–Cu alloy samples containing Mo 0.5 to 1.2 and Cu 0.5 to 0.8%. The chemical composition, points of allotropic transformations, coefficient of thermal expansion, plasticity after hot and cold forming, and structural morphology of these alloys were studied. The transformation points C_1, C_2, R_1, and R_2 were 775, 851, 739, and 790°C, respectively. The coefficient of thermal expansion was tabulated for temperatures between 20 and 700°C for both a temperature increase and a decrease. The investigations of the plasticity showed differences in hardening. Cross-rolled samples were less hardened than those rolled longitudinally. The mechanical strength of the hardened samples decreased, while their ductility increased twice or three times. X-ray analysis results indicated texture in the samples and in addition to α-Zr, lines were found corresponding to a cubic $ZrMo_2$ and a tetragonal Zr_2Cu. The study of the mechanism and kinetics of transformations showed a considerable difference in comparison with the transformation of austenite in steel. The morphological variety of the products of transformation was considerably affected by the presence of air. A detailed study of protective atmospheres may be therefore necessary. (Nuclear Sci. Abstr. Czech.)

16335 THERMODYNAMIC STUDY OF THE LIQUID TERNARY GALLIUM–INDIUM–ZINC SYSTEM AT 723°K. Gambino, M. (Univ., Marseille); Bros, J. P.; Ansara, I. pp 233-240 of Thermochimie. Thermochimie Generale. Paris; Centre National de la Recherche Scientifique (1972). (In French).

From conference on thermochemistry; Paris, France (1972).

The heats of formation of gallium–indium–zinc alloys were measured at 723°K using calorimetry. The results are compared with different empirical interaction models based on the limiting binary data: these results, combined with the partial free energies of mixing of the binary systems, are the basis for calculation of the liquidus in the ternary system throughout the whole range of composition. (auth)

16336 THERMODYNAMIC PROPERTIES OF LIQUID K–Na ALLOYS. Lantratov, M. F. (Leningrad Polytechnic Inst.). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 7, 1584-1587(Jul 1973).

Translated from Zh. Prikl. Khim.; 46: No. 7, 1485-1488(Jul 1973).

Results of thermodynamic studies show that relatively small positive–negative deviations of the activity of potassium and only negative deviations of the activity of sodium were found to occur in K–Na solutions. This behavior of the alloys is attributed to existence of structural groups of the intermetallic compound Na_2K in the liquid alloy. Alloy formation is accompanied by an exothermic heat effect. The molar entropy of mixing indicates the existence of short-range order in K–Na alloys. Formation of liquid potassium–sodium alloys is accompanied by contraction. (auth)

16337 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Band 7, Heft 11, November 1973. 215 Referate (Register-Nr. 4365-4758), 128 Referate (Register-Nr. 823T-950T). (Plutonium Documentation. Transplutonium Elements. Abstract Journal. Volume 7, No. 11, November 1973. 215 Abstracts (Register No. 4365-4758), 128 Abstracts (Register No. 823T-950T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). 132p. (In German and English).

16338 MASS-SPECTROMETRIC METHOD FOR ANALYZING DIFFUSION OF LITHIUM, USING p–n JUNCTIONS FOR SIMULTANEOUS DETECTION OF Li-6 AND Li-7 IONS. Walling, J. D. Troy, NY; Rensselaer Polytechnic Inst. (1973). 174p. University Microfilms Order No. 73-27,240.-

Thesis (Ph. D.).

A mass-spectrometric method for determining the diffusion of lithium through rhenium and tungsten at high temperatures was studied. In order to examine diffusion with very dilute solute concentrations, a cascade ion beam analyzer was modified to provide for a diffusion controlled thermal ionization source and a detection method capable of independent single ion counting at atomic masses 6 and 7. Attempts were made to determine the diffusion coefficients, per se, but measurements of these were obscured by parameters such as work function changes, irregularities in the encapsulation, and temperature profiles along the filament that were not easily amenable to control. Nevertheless, diffusion related data were obtained for lithium through rhenium and tungsten in the temperature region of 800 to 1650°C. From these data, conclusions concerning improvements in the source design were made. (JRD)

16339 TUNGSTEN NEWS, OCTOBER 1973. Tungsten News; 1-20(Oct 1973).

Research and development activities in W technology are reviewed. Information is presented on W metal, W-base alloys and fiber-reinforced materials, recovery and processing of W, and other W compounds. (388 references) (JRD)

16340 TUNGSTEN NEWS, JANUARY 1974. Tungsten News; 1-20(Jan 1974).

Research and development activities in W technology are reviewed. Information is included on W metal, refractory W tool materials, W-base alloys, composite materials, recovery and processing of W materials, and W compounds. (411 references) (JRD)

16341 MOESSBAUER STUDY OF PRECIPITATION IN Fe–Ni–Mo AND Fe–Ni–Co–Mo MARAGING ALLOYS. Genin, J. M. (Ecole des Mines, Nancy); Le Caer, G.; Maitrepierre, P.; Thomas, B. J. Scr. Met.; 8: No. 1, 15-22(Jan 1974).

Mössbauer spectroscopy was used to study the aging behavior of an Fe–12.2 at.% Ni–6.2 at.% Mo alloy and an Fe–17.3 at.% Ni–8.4 at.% Co–2.9 at.% Mo alloy for which a considerable amount of information relative to the precipitation processes had already been obtained by classical techniques such as hardness measurements, electron microscopy, and x-ray diffraction. The Mössbauer experiments were performed at room temperature on electrolytically thinned 20μ-thick foils using an ELRON transmission Mössbauer spectrometer and a ^{57}Co source in a palladium matrix. The Mössbauer experiments performed on the quaternary Fe–Ni–Co–Mo alloy show that the homogeneous precipitation observed at low temperature in Fe–Ni–Co–Mo and in certain Fe–Ni–Mo alloys corresponds to the segregation of Mo atoms into Mo-rich zones which are virtually Fe-free. This confirms again the general tendency of Mo to cluster in these Fe–Ni and Fe–Ni–Co matrices. These results imply that the formation of the ordered structure involves not only the segregation of molybdenum atoms onto every third $(111)_\alpha$ plane but also the replacement of iron atoms on the other $(111)_\alpha$ planes within the precipitates by nickel and/or cobalt atoms. (auth)

Radiation Effects

Refer also to abstracts 15454, 16376, 16377, 17573, 17574, 17581, and 17593.

16342 (CONF-730942-P5, pp vp Paper L 3/2) PLASTICITY OF IRRADIATED MATERIALS. Perzyna, P. (Inst. of Fundamental Technological Research, Warsaw). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A mathematical structure of a thermodynamic theory of time-dependent irradiated materials is given. In this theory an internal variable description is utilized. It has been shown to what extent thermodynamics helps in the proper description of internal dissipation when both thermo-mechanical coupling and irradiation effects are taken into account. A set of rules of interpretations for internal state variables introduced is given. These rules are based on the analysis of dissipative mechanisms for time-dependent plastic flow of irradiated materials and on available experimental data. The deformation tensor, temperature, temperature gradient and the flux of irradiation are assumed as a local configuration of a particle X, while the inelastic deformation tensor, the work-hardening parameter and the concentration of defects are introduced as internal state variables. Basing on the thermal activated process for irradiated materials the evolution equations for the internal state variables are postulated. In formulation of these equations a particular importance is attached to the description of significant changes induced by neutron irradiation, e.g., the increase of the yield stress, radiation hardening, the saturation effect and temperature dependent annealing effect are taken into consideration. Particular cases of this theory are discussed and simple constitutive equations which can be used in practical engineering reactor technology are obtained. Theoretical assumptions are compared with available experimental data. (auth)

16343 (CONF-731028-5) REVIEW OF ION SIMULATION OF HIGH-TEMPERATURE NEUTRON DAMAGE AND VOID FORMATION. Kulcinski, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Atomic Power Div.). 1973. 26p. Dep. NTIS $3.50.

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973).

The ion-bombardment simulation technique has made notable discoveries about the formation of voids in metals. The simulation studies are now giving a preview of what to expect after long-term high-temperature neutron bombardment and it is a quick, easy, and economical tool to screen new alloys. Future work of a basic nature will undoubtedly contribute to void nucleation and growth theories. It is possible that the simulation technique will be even more valuable to the controlled thermonuclear reactor program than it has been to the LMFBR program. (14 figures, 89 references) (auth)

16344 (COO-1367-56) EFFECT OF POINT DEFECTS ON MECHANICAL PROPERTIES OF METALS. Technical Progress Report. Meshii, M. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Materials Science). 1973. Contract AT(11-1)-1367. 14p. Dep. NTIS $3.00.

The major research effort was on iron. The recovery of the electron irradiation effect was studied in pure iron and iron–carbon alloys. This investigation resulted in several new findings in addition to the confirmation of two assumptions used in the interpretation of the mechanical effects of electron irradiation on high-purity iron single crystals. The irradiation softening effect was studied in single crystals oriented for the (011) slip and polycrystalline specimens. Then, a striking orientation effect was discovered and a large irradiation softening was found in single crystal specimens oriented for the hard (121) slip. In this orientation, more than 60% of the yield stress is reduced by electron irradiation; thereby, the hardest orientation becomes the softest orientation following electron irradiation. The solution softening and hardening effects of carbon atoms were investigated using high-purity iron single crystals similar to those used in the irradiation-softening study. The general behavior of the softening and hardening was in good agreement with a proposed theory based on the irradiation-softening experiments. (auth)

16345 (HEDL-SA-581) HIGH-STRAIN-RATE TENSILE PROPERTIES OF IRRADIATED ASTM A533-B PRESSURE VESSEL STEEL. Heavy Section Steel Technology Program Technical Report No. 32. Steichen, J. M.; Williams, J. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1973. Contract AT(45-1)-2170. 38p. (CONF-731044-1). Dep. NTIS $4.00.

From TMS/AIME fall meeting; Chicago, Illinois, USA (1 Oct 1973).

For Oak Ridge National Lab., TN.

The effect of deformation rate and temperature on the tensile properties of unirradiated and irradiated ASTM A533-B steel was determined for strain rates from 6.7×10^{-5} to 100 sec^{-1} and temperatures from −321 to 500°F. Test material was irradiated at 510°F to fluences from approximately 0.4 to 6.5×10^{19} n/cm^2 (E > 1 MeV). Results of this study indicated tensile properties of A533-B steel are strongly strain rate, temperature, and fluence dependent. The unirradiated behavior was as follows: increasing strain

rate greatly increases the yield strength at −250°F (~10 ksi per order of magnitude increase in strain rate) and only slightly increases yield strength at 72 and 500°F (~3 and 1 ksi, respectively); the ultimate strength is less rate sensitive than the yield strength; and ductility (total elongation) rapidly decreases with increasing strain rate at −250°F, and at 72 and 500°F it remains constant with strain rate. The irradiated behavior was as follows: at all test temperatures ultimate and yield strength increase with fluence; increasing strain rate increases the yield strength at each fluence and test temperature, however, strain rate sensitivity is reduced by increasing fluence; irradiation reduces ductility at all temperatures and strain rates, and the decrease appears to be fluence-dependent; and cleavage fractures occurred in irradiated tensile specimens when the yield stress was elevated to approximately 150 ksi by increasing strain rate or decreasing temperature. Ductile fractures were observed in the unirradiated specimens for all test conditions. The yield strength, using the wide range of test parameters of this study, was correlated with the rate−temperature parameter, T ln A/$\dot{\epsilon}$. The completed correlation provides accurate strength values for any temperature, strain rate, or fluence within the range of this study and provides a means to predict stress−strain behavior at the various temperatures and strain rates. (18 figures, 4 tables) (auth)

16346 (WAPD-TM-1095) EFFECT OF POST-IRRADIATION ANNEALING AND RE-IRRADIATION ON THE FRACTURE PROPERTIES OF A302B PRESSURE VESSEL STEEL. Hall, J. F.; Seman, D. J. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jul 1973. Contract AT(11-1)-GEN-14. 39p. Dep. NTIS $4.00.

Three heats of A302B steel were studied. The beneficial effects derived from post-irradiation annealing were defined in terms of the percent recovery in the 30 ft-lb transition temperatures and in the fracture mechanics transition temperatures. Annealing temperatures of 625 and 650°F and annealing times of 3 to 81 days were used in the study. Re-irradiation behavior was determined by observing the effects of re-irradiation on fracture toughness and comparing measured and predicted values of changes in the fracture mechanics transition temperatures. The benefits of annealing to fracture toughness were shown to be commensurate with benefits obtained for the Charpy transition temperature. (14 figures, 8 tables) (auth)

16347 EFFECT OF n,γ IRRADIATION ON THE HIGH-TEMPERATURE CORROSION OF Kh18N10T STEEL IN N_2O_4. Sukhotin, A. M.; Fedyushin, E. E.; Matushkin, V. A.; Gerasimova, V. A. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 19-23(1973). (In Russian).

An assembly for resistometric study of corrosion kinetics of metallic materials in N_2O_4 at high temperatures and pressures is described. The kinetic curve of radiational corrosion of steel Kh18N10T in N_2O_4 is shown. (auth)

16348 DEPENDENCE OF SPACE DISTRIBUTION OF PARTICLES SPUTTERED FROM MONOCRYSTALLINE COPPER ON ION-INCIDENCE ANGLE. Bukhanov, V. M.; Morozov, V. G.; Yurasova, V. E. (Moscow State Univ.). Radiat. Eff.; 19: No. 4, 215-218(Aug 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Sep 1972).

The dependence of the angular distribution of atoms sputtered from the (001) monocrystalline copper face on the incidence angle of 22-keV neon ions was studied. Use is made of well-known ideas defining the observed distribution as a result of superposition of the directed atomic yield along the close-packed axes and of the random yield along all directions. The values obtained for the relative contribution of the directed and random sputterings indicate that the dependence of these values on the ion incidence angle is distinctly anisotropic. The yield of the directed sputtering had a minimum value when the incidence directions of the bombarding ions coincided with the low-index crystallographic axes. In addition, the width of ⟨011⟩ and [001] pattern spots was also found to be an anisotropic function of the ion incidence angle. The spots have the smallest width when the direction of ion incidence coincides with the low-index axes. The observed dependences are discussed on the basis of the focusing mechanism of the sputtered atom yield. (auth)

16349 INTERNAL FRICTION OF ELECTRON-IRRADIATED COLD-WORKED ALUMINIUM. Fantozzi, G.; Perez, J.; Benoit, W.; Moser, P.; Kabsch, Z. (Univ. Lyon, Villeurbanne, France). Radiat. Eff.; 19: No. 4, 277-279(Aug 1973).

Cold-worked aluminium presents several internal friction peaks: the Bordoni peaks B_1 and B_2 attributed to dislocation kink relaxation; and the Hasiguti peaks P_A and P_B explained in terms of interactions between dislocations and point defects. The purpose of the present note is to establish the nature of the defect interacting in the Hasiguti peaks; it is shown that it is possible to create a peak by introducing irradiation point defects into a sample containing convenient dislocations and that this peak presents all the characteristics of a classical P_B peak. (UK)

16350 PECULIARITIES OF ION SCATTERING BY CRYSTALS DUE TO SURFACE HALFCHANNELS FORMED BY CLOSE PACKED ATOMIC ROWS. Skripka, Yu. G. (Donetsk State Univ., USSR). Radiat. Eff.; 19: No. 4, 211-213(Aug 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Sep 1972).

The angular and energy distributions of ion scattering by the surface of crystals were studied when there are halfchannels on the crystal surface, which are formed by close packed atomic rows of the first and the second layers of crystals. Copper crystals (100) and (110) were bombarded by 30-keV Ar^+ ions. Results are compared with those for ion scattering by lattice structure when there are no surface halfchannels. (auth)

16351 SURFACE DAMAGE AND TOPOGRAPHY OF ERBIUM METAL FILMS IMPLANTED WITH HELIUM TO HIGH FLUENCES. Blewer, R. S. (Sandia Labs., Albuquerque, NM). Radiat. Eff.; 19: No. 4, 243-248(Aug 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Sep 1972).

Topographical and expansion effects which occur as a result of implanting erbium thin films with helium up to fluences of 1.5×10^{18} He^+/cm^2 are described. There exists an inverse relationship between critical dose and annealing temperature with respect to the formation of surface bubbles. Postimplantation annealing at or below 400°C is found to strongly reduce implantation-induced expansion for doses less than 3.5×10^{17} He^+/cm^2, but is observed to result in increased expansion above this dose. At temperatures above 400°C, expansion is increased for all doses investigated. Details of bubble development in the implanted layer are discussed and the manner in which surface bubbles develop from enlarged subsurface bubbles is illustrated. (auth)

16352 DOSE DEPENDENCE OF 45-keV V^+ AND Bi^+ ION SPUTTERING YIELD OF COPPER. Andersen, H. H. (Aarhus Univ., Denmark). Radiat. Eff.; 19: No. 4, 257-261(Aug 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Sep 1972).

The sputtering yield of 45-keV V^+ ions on copper is found to decrease with increasing dose even for very large doses, while the yield of 45-keV Bi^+ ions on copper increases with increasing dose until approximately ten times the projected range of the Bi^+ ions was sputtered away. The fate of the incoming V^+ and Bi^+ ions was investigated. A radiotracer technique showed that vanadium accumulated on the target surface, while bismuth diffused into the target, as was seen by means of Rutherford scattering of light ions. (auth)

16353 RECOVERY OF IRRADIATED Fe−1.45%Cr−C ALLOYS. Takahashi, J.; Yamane, T.; Mima, G. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); No. 10, 587-590(Oct 1973).

This study was carried out on Fe−1.45%Cr−C alloys to study the annealing process after irradiation through internal friction measurements and torsional tests. The irradiation was carried at about 70°C to a neutron dose of $\sim 1.0 \times 10^{18}$nvt(>1 MeV) in JMTR. The following results were obtained: (1) the addition of Cr atoms retards the resolution of C atoms, and (2) in irradiated specimens, the recovery behavior determined from torsional tests is almost identical to that from the Snoek-peak measurements. (auth)

16354 REVIEW ON STUDY OF MATERIAL SCIENCE BY HEAVY-ION BOMBARDMENT. Nagasaki, R. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 15: No. 7, 458-468(Jul 1973). (In Japanese).

Recently in the fields of fast reactor material and fuel, new phenomena such as swelling of fuel cladding have been found and become big problems. Research on these problems requires an enormous amount of time, labor and cost. Therefore, the use of heavy ions to simulate neutrons becomes important, and the correlation between neutron irradiation and ion irradiation must be clarified experimentally and theoretically. The following topics are discussed: characteristics of irradiation test by heavy ion accelerator; selection of accelerator (low-energy accelerator, high-energy accelerator); comparison of irradiation damages by fast neutrons and by charged particles; ion sources; fundamental studies of material science by heavy-ion irradiation (interaction of crystal particles and fission products, channeling, ion injection, atomic collision); technical and engineering studies of material science by heavy-ion irradiation (Se irradiation, proton irradiation, Ni irradiation, α-particle irradiation, carbon irradiation, void formation and its regularity). (JA)

16355 RADIATION DAMAGE OF METALLIC MATERIALS. Shiraishi, K. (Japan Atomic Energy Research Inst., Tokai). Zairyo Kagaku; 9: No. 3, 135-140(Jun 1972). (In Japanese).

In recent years attention has been directed to the radiation damage of metallic materials, from exposures 10^{22} n/cm^2 or more of fast neutrons, in order to evaluate the scope of damage in core materials for fast-breeder reactors and fusion reactors. Electron beams and heavy ions, as well as fast neutrons, have been utilized as radiation for studying this problem. Scope and characteristics of the radiation damage of metallic materials by different radiations are described. In order to compare the damage done by different kinds of radiation, a value called displacement per atom, dpa, has been used for convenience. The dpa is calculated as N_d/N_0, where N_d is number of atoms flipped out, and N_0 is number of atoms per unit volume of metal. In the swelling of austenitic stainless steel, fuel cladding material used for fast neutron reactors, the volume of the stainless steel changed by 10% upon exposure to fast neutrons of 1×10^{23} n/cm^2 at dpa 100. In case of a 1-MeV electron beam at 1 A/cm^2 for 1 h, the dpa of iron is calculated as 1.1. Compared by dpa only, the damage suffered from an electron beam in the uhv electron microscopes is far greater than the damage by the fast neutrons. Further, the dpa of iron exposed to the ionic radiation is calculated as 110. Comparison by the dpa only is not satisfactory. Quantitative comparison of radiation damage of metallic materials on the dpa basis obtained from a simplified model under the different radiations is reported. (JA)

16356 PLASTICITY OF IRRADIATED MATERIALS. I. Experimental Motivations and General Theory. Perzyna, P. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 21: No. 10, 499-505(1973).

Experimental results for irradiated materials are discussed and a simple physical model of time-dependent plastic flow is given. A mathematical structure of a thermodynamic theory of time-dependent irradiated materials is presented. It is shown to what extent thermodynamics helps in the proper description of internal dissipation when both thermo-mechanical coupling and irradiation effects are taken into considerations.

16357 PLASTICITY OF IRRADIATED MATERIALS. II. Thermomechanical Coupling. Perzyna, P. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 21: No. 10, 507-513(1973).

A set of rules of interpretations for internal-state variables introduced is given. These rules are based on the analysis of dissipative mechanisms for time-dependent plastic flow of irradiated materials and on available experimental data. The evolution equations for the internal-state variables are postulated. In formulation of these equations a particular importance is attached to the description of significant changes induced by neutron irradiation; e.g., the increase of the yield stress, radiation hardening, the saturation effect, and temperature-dependent annealing effect are taken into considerations. Analysis of thermomechanical coupling in the presence of irradiation effects is given. Assumptions under which the thermal-radiation process is completely decoupled from the mechanical state of the process are discussed. (35 references) (auth)

16358 STRUCTURAL CHANGES IN DIFFERENT FACES OF MONOCRYSTALS OF REFRACTORY METALS DUE TO ION BOMBARDMENT. Klein, G. A.; Sokolova, V. P.; Krakhmalev, V. A. pp 119-126 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Results of experimental work are presented on changes in the relief of different faces of molybdenum and tungsten monocrystals as a result of the action on them of a beam of cesium ions in a high vacuum, 10^{-6} mm Hg, and a glow discharge in cesium and mercury vapors at pressures of 10^{-1} to 10^{-3} mm Hg. (tr-auth)

16359 WORK FUNCTION OF MONOCRYSTALS OF METAL COMPOUNDS (EPSILON PHASE) IN A Mo–Rh SYSTEM. Savitskii, E. M.; Burov, I. V.; Litvak, L. N.; Savel'ev, Yu. A. pp 211-216 of Struktura i Svoistva Monokristallov Tugoplavkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The work function was determined, in a vacuum of 10^{-9} mm Hg, of monocrystals of metal compounds (epsilon phase) in the molybdenum–rhodium system at the (0001), (10$\bar{1}$2), and (11$\bar{2}$4) faces. From the slope of the Richardson curves, the following values were obtained: $\gamma_{(0001)} = 4.87$ eV, $\gamma_{(10\bar{1}2)} = 4.46$ eV, and $\gamma_{(11\bar{2}4)} = 4.30$ eV. (tr-auth)

16360 REMARKS ON THE THEORY OF THE SWELLING OF METALS IRRADIATED WITH FAST NEUTRONS. Kostritsa, A. A.; Chekushina, L. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 76-78(1973). (In Russian).

The diffusion model of the swelling of metals under the influence of neutron irradiation and its correspondence with experimental data are discussed. (tr-auth)

16361 INFLUENCE OF NEUTRON BOMBARDMENT ON THE MECHANICAL PROPERTIES OF TITANIUM AND THE MAGNITUDE OF THE PROGRAMMED-HARDENING EFFECT. Gindin, I. A.; Lapiashvili, E. S.; Naskidashvili, I. A.; Nekliudov, I. M. (Physical-Technical Inst., Kharkov). Probl. Prochnosti; 5: 49-52(Aug 1973). (In Russian).

Using polycrystalline titanium samples, it is shown that under the influence of a smoothly increasing load, radiation defects are redistributed into energetically favorable positions, resulting in the formation of structures of high elastic stiffness. Neutron bombardment 3.2×10^{18}n/cm^2 at 130°C increases the yield point of titanium by 40%. Bombardment with subsequent annealing under a smoothly increasing load increase the yield point by a factor of 2. (IAA)

16362 RELATION BETWEEN HASIGUTI PEAKS AND PINNING STAGES IN COLD-WORKED AND ELECTRON-IRRADIATED COPPER. Sokolowski, G.; Luecke, K. (Technische Hochschule, Aachen). (1973). vp.

From 5th international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

In the low frequency region two groups of experiments after cold-work have been reported: In one group attention is directed to modulus measurements and results are discussed in terms of dislocation pinning. In the other group, attention is concentrated on damping measurements which are used in studies of the Hasiguti peaks. The purpose of the experiment, however, is to measure at 1 Hz both quantities simultaneously and to find connections between them. Cold-work and electron irradiation of 99.999 ASARCO-copper are considered. (GE)

Other Materials

Refer also to abstracts 17425, 17997, 18001, 18008, 18009, 18016, and 18017.

16363 (CEA-CONF-2144) STUDY OF DEFECTS PRODUCED BY ION IMPLANTATION OF SILICON (III) USING TRANSMISSION ELECTRON MICROSCOPY. Truche, R.; Dupuy, M.; Lafeuille, D. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 8 Jun 1973. 18p. (In French). (CONF-730574-9). Dep. NTIS (U. S. Sales Only) $3.00.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

Silicon samples were implanted with phosphorus (10^{16} atoms/cm^2 at 30 keV) and arsenic (10^{15} atoms/cm^2 at 50 to 140 keV). In the case of phosphorus, electron microscope observations revealed an amorphous layer epitaxially recrystallizing on the substrate at 650°C. The behavior of defects such as dislocation loops and dipoles were studied during annealing at higher temperatures. In the case of arsenic, the recrystallization of the amorphous layer was accompanied by microtwinning and the formation of various types of defect (loops, linear defects etc.). (FR)

16364 (COO-1198-1025) POINT DEFECTS IN SEMICONDUCTORS. Koehler, J. S. (Illinois Univ., Urbana (USA)). 1973. Contract AT(11-1)-1198. 10p. (CONF-731054-1). Dep. NTIS $3.00.

From conference on point defects; Tbilisi, USSR (15 Oct 1973).

It does not seem likely that an adequate theory of defects in semiconductors will be achieved in the near future, although this could happen if some simple approximate scheme of calculation could be shown to give results in agreement with present experimental findings. New observations are needed which can identify the particular defect involved. For example it would be helpful to identify certain infrared absorption bands with vacancies in definite charge states. Thus far nothing has been said about defects in III-V or in II-VI compounds. Since a vacancy in a type III site differs from a vacancy in a type V site, it is evident that the situation is more complicated in such compounds than in the valence IV semiconductors. (16 references) (auth)

16365 (GERHTR-61) IRRADIATION-INDUCED CHANGES OF THERMAL EXPANSION (C.T.E.) OF NUCLEAR GRAPHITE. Delle, W. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). 1971. 8p. Dep. NTIS $3.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

The coefficient of linear thermal expansion (C.T.E.) increases at

low fluences up to about 30%. At irradiation temperatures below 600°C it stays, with increasing fluence, higher than before irradiation. At higher temperatures thermal expansion decreases with increasing fluence up to 80% below the initial value. The C.T.E. increase can be explained by the lack of buffering by closing of microcracks. A decrease is possible when new space for buffering of the crystallite expansion in "c" direction is available, owing to void clustering and migration. The decrease of C.T.E. is crystallite size dependent—the smaller the crystallites the greater the fractional decrease. Graphites with high crystallinity (natural flake and needle coke) do not show such decrease. (auth)

16366 (GERHTR-69) CHANGE IN ORIENTATION ANISOTROPY AND MICROPOROSITY IN PYROLYTIC CARBON. Koizlik, K.; Krautwasser, P.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). Mar 1973. 7p. Dep. NTIS $3.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

Fragments of pyrocarbon coatings were obtained from coated fuel particles and annealed for 3 h at 1800 to 2800°C. The annealing increased the orientation anisotropy, but the increase was only 20%, and most of the change occurred at 2000 to 2200°C. Results are interpreted as being due to diffusion of vacancies. (DLC)

16367 (GERHTR-73) MASS SPECTROMETRIC ANALYSIS OF GAS COMPOSITION DURING THE FORMATION OF PYROLYTIC CARBON FROM METHANE. Luhleich, H.; Suetterlin, L.; Pflaum, P.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe). 1972. 20p. Dep. NTIS $3.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

A study was made of the formation mechanism of pyrolytic carbon by analyses of the gaseous products evolved during the pyrolysis of methane on a heated W wire. Pyrolytic temperatures were 1640, 1680, and 1710°C. A steep drop in the electric resistance of the wire occurred when the ethane content reached its maximum and the separation of the pyrolytic carbon on the wire started. The duration of the starting phase and the pyrolysis temperature are correlated: $t_A = 1.48 \times 10^{-3} \exp (2.88 \times 10^4\ T^{-1})$s. (DLC)

16368 (GULF-GA-A-12615) REVIEW OF THE THERMAL CONDUCTIVITIY OF NUCLEAR GRAPHITE UNDER HTGR CONDITIONS. Price, R. J. (Gulf General Atomic Co., San Diego, Calif. (USA)). 7 Sep 1973. 75p.

Experimental data on the thermal conductivity of needle-coke and isotropic graphites irradiated between 500 and 1600°C are reviewed. Irradiation reduces the room-temperature thermal conductivity; as the fluence increases, the rate of reduction declines and the conductivity approaches a saturation level which increases as the irradiation temperature increases. Eventually, when irradiation-induced expansion starts, the conductivity again decreases. The time constant for approach to saturation appears to increase linearly with irradiation temperature, while the conductivity after saturation increases exponentially with irradiation temperature. Irradiation reduces the dependence of the thermal conductivity on measurement temperature. Theoretical treatments of thermal conduction in irradiated graphite based on the lattice dynamics of hexagonal crystallites in the presence of crystallite boundaries and point defects are fairly well developed. Single vacancies and small interstitial clusters are believed to control the thermal conductivity of graphite irradiated below 300°C; between 300 and 650°C vacancies alone dominate, while above 650°C vacancy loops play an increasingly important role. The main practical application of the theoretical model is that it enables the temperature dependence of the conductivity of irradiated graphite to be predicted once measurements have been made at a single temperature. Design-basis curves for the thermal conductivity of irradiated H-327 and H-451 graphites were derived from the lattice dynamics model, assuming that the important irradiation-induced defects are vacancies or vacancy loops which are small compared with phonon wavelengths. The necessary parameters were obtained from analysis of experimental measurements on unirradiated H-327 and H-451 graphite, together with published data on the room-temperature conductivity of irradiated needle-coke graphites and Gilsocarbon graphites. (32 figures, 9 tables, 32 references) (auth)

16369 (RISO-M-1658) MAGNETISM OF NaCl-TYPE URANIUM COMPOUNDS. Danielsen, O. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The magnetic properties of the actinides are caused by the 5f electrons. A localized model as well as a band model describing the magnetic properties are presented. The magnetic properties of the NaCl-type uranium compounds are summarized with special attention to UP and US. (9 figures, 17 references) (auth)

16370 OPTICAL BLEACHING BEHAVIOUR OF NEUTRON-IRRADIATED KCl SINGLE CRYSTAL. Suh, I. S. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 4, 286-290(Dec 1973).

Hydroxide-free KCl single crystals were prepared and doped with small amounts of KSH or K_2S. The samples were subjected to neutron irradiations while keeping them at liquid nitrogen temperature in the dark. The irradiated ones are then bleached by using a uv lamp and analysed as four different chemical forms of ^{35}S whose valence states are −2, 0, +4, and +6. The sulfide fraction of ^{35}S in doped crystals is higher than that in pure crystals. In addition, two distinct patterns in the bleaching process up to 30 minutes result in a fast increase in the sulfide fraction, and then the sulfide levels off to a slowly increasing region upon prolonged bleaching. A detailed description on the distribution of ^{35}S valence states is made in connection with point defects in the crystals. (auth)

16371 ANNEALING BEHAVIOUR OF ARSENIC IMPLANTS IN SILICON. Baldo, E.; Cappellani, F.; Restelli, G. (Joint Inst. of Nuclear Research, Ispra, Italy). Radiat. Eff.; 19: No. 4, 271-275 (Aug 1973).

The annealing behavior of 80-keV room-temperature arsenic implants in silicon below the amorphization dose was studied by comparing the physical profile and the electrical profiles following different isochronal anneals. It is shown that the electrically active fraction, which is about 0.4 after 30 min annealing at 600°C, increases continuously until 100% electrical activation of the arsenic ions is reached at about 900°C. The activation energy for the annealing process has been found equal to 0.4 eV. A tentative interpretation of the mechanism involved is given. From the analysis of the physical profiles obtained after isochronal annealing, an effective diffusion coefficient at 900°C equal to 5×10^{-16} cm^{2}s^{-1} has been calculated. (auth)

16372 INFLUENCE OF ION-BOMBARDMENT-INDUCED RADIATION DAMAGES IN THE CRYSTAL LATTICE ON ANGULAR REGULARITIES IN ION SCATTERING. Arifov, U. A.; Aliev, A. A. (Tashkent Inst. of Electronics). Radiat. Eff.; 19: No. 4, 231-234 (Aug 1973).

From international conferenoe on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Sep 1972).

The paper examines the angular, spatial, and energy distribution of 50 to 1200-eV Na^+ ions scattered by various faces of silicon and germanium single crystals. It is shown that, due to the orderly arrangement of atoms in the crystal lattice, the orientation effects in the angular, spatial, and energy distributions are observed at temperatures exceeding the annealing temperature of ion-bombardment-induced radiation damage. At high temperatures of the sample, a reduction of the anisotropy in the angular, spatial, and energy distributions of scattered ions was observed which is due to the changing transparency of the crystal resulting from the thermal vibrations of atoms in the lattice. Results of investigations testify to the possibility of using the orientation dependences of phenomena occurring during the interaction of ions with crystals for determining the annealing temperature of ion bombardment damage and for studying the kinetics of the process of ion bombardment. It is shown that further studies along the same lines could develop a technique for the quantitative estimation of ion-bombardment damage in crystals and also in thin epitaxial films. (auth)

16373 DETERMINATION OF TRITIUM DIFFUSION COEFFICIENT AND ACTIVATION ENERGY IN LiF CRYSTALS. Tsetskhladze, T. V.; Ekvtimishvili, N. I.; Kharebava, I. A. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 72: No. 1, 53-56(Oct 1973). (In Russian).

In the reactor irradiation of LiF single crystals, the $^6Li(n,\alpha)$ reaction occurs and tritium is produced. The diffusion coefficient was measured in the temperature range of 450 to 750°C, and the activation energy estimated as 1.72 ± 0.02 eV. (auth)

16374 ANOMALOUS F-CENTER DISTRIBUTION IN ALKALI HALIDES IRRADIATED WITH 1.5-MeV PROTONS TO HIGH FLUENCES. Wardle, M. W.; Murray, R. B.; Zimmerman, M. L. (Univ. of Delaware, Newark). Solid State Commun.; 13: No. 11, 1825-1828(1 Dec 1973).

Crystals of KCl and KI irradiated to fluences of the order of 10^{16} protons/cm^2 exhibit an anomalous dip in F-center profile near the end of the proton penetration depth. This effect is shown to arise from the destruction of F centers by hydrogen capture, forming U centers in a distribution whose peak coincides with the proton range. (auth)

16375 EFFECT OF NEUTRON DOSE AND BORON DOPING ON X-RAY DIFFRACTION IN NEUTRON-IRRADIATED Si AND Ge. Baldwin, T. O. (Southern Illinois Univ., Edwardsville); Dunn, J. E.; Thomas, J. E. Jr.; Chen, P. N. Cryst. Lattice Defects; 4: No. 3, 211-218(1973).

The anomalous x-ray transmission and diffuse x-ray scattering were examined in both boron-doped and undoped crystals of neutron-irradiated silicon and germanium at two different doses. Results indicate that these physical properties increase nonlinearly with dose and that boron has little effect on the resultant damage. The diffuse x-ray intensities increase faster with dose than does the anomalous x-ray absorption. Annealing studies suggest that clustering begins at T ≥ 500°C in germanium after the crystal appeared to be completely annealed. Cluster damage produced from the fissioning of ^{10}B appears to be negligible compared to the fast-neutron damage. (auth)

16376 FAST-ELECTRON IRRADIATION EFFECT ON GERMANIUM SURFACE PROPERTIES. Bolotov, V. V.; Vasil'ev, A. V.; Misurkin, O. G.; Potapova, L. P.; Shirov, D. G. Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 5, 50-53(1973). (In Russian).

The changes of the surface electrostatic potential (SEP) on high- and low-ohmic germanium p and n samples with a protective cover and without it were examined by electron irradiation with energy 3.5 MeV in the irradiation stream of 10^{13} to 10^{16} cm^{-2}. It was found that there exists a region of the original surface state where the changes in the SEP value slightly depend on the irradiation dose. (auth)

16377 GAS ATMOSPHERE INFLUENCE ON SURFACE ELECTROSTATIC POTENTIAL CHANGE IN GERMANIUM SUBJECTED TO FAST-ELECTRON IRRADIATION. Bolotov, V. V.; Vasil'ev, A. V.; Misurkin, O. G.; Potapova, L. P.; Shirov, D. G. Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 5, 119-121(1973). (In Russian).

The results of the change in the surface electrostatic potential of germanium crystals irradiated in oxygen atmospheres, wet and dry air, nitrogen, and argon by electrons with 3.5 MeV energy are given. The essential influence of gaseous environments on the character of the radioinduced changes in the surface properties is noted. (auth)

16378 STANDARD METHOD FOR MEASUREMENT OF LATTICE SPACING OF NUCLEAR GRAPHITE. 1973 Annual Book of ASTM Standards. Part 13. Philadelphia; American Society for Testing and Materials (1973). 2p. (ASTM-C-558-69).

This method covers the measurement of the characteristic lattice space in the (00.l) and (110) crystallographic directions in nuclear graphite. Camera and diffractometer procedures are given. (DLC)

16379 STANDARD METHOD OF TEST FOR DELTA-IN-HOURS (DIH) PURITY OF NUCLEAR GRAPHITE. 1973 Annual Book of ASTM Standards. Part 13. Philadelphia; American Society for Testing and Materials (1973). 2p. (ASTM-C-624-71).

The difference in thermal neutron absorption between graphite standard and test bars inserted in the reactor is measured in units of in-hours, called "delta-in-hours." Procedures are given for measuring this parameter. (DLC)

16380 STANDARD RECOMMENDED PRACTICE FOR REPORTING IRRADIATION RESULTS ON GRAPHITE. 1973 Annual Book of ASTM Standards. Part 13. Philadelphia; American Society for Testing and Materials (1973). 1p. (ASTM-C-625-72).

The purpose is to identify sample and test parameters that may influence graphite irradiation test results. (DLC)

16381 MECHANICAL SCAN SYSTEM FOR ION IMPLANTATION. Robertson, G. I. (to Western Electric Co., Inc.). US Patent 3,778,626. 11 Dec 1973. Filed date 28 Jul 1972. 12p.

Workpieces to be implanted with a uniform ion dose are attached to a major surface of a target positioned in the path of an ion beam. The target is rotated and traversed so that the ion beam traces segments of spiral paths on each workpiece. The uniformity of the ion dose in the workpieces is controlled by regulating the position of the target during each traversal according to the accumulated ion dose, or by regulating the traversing speed according to the ion beam current. (Official Gazette)

16382 SPECIFIC HEAT OF GRAPHITE: AN EVALUATION OF MEASUREMENTS. Butland, A. T. D.; Maddison, R. J. (United Kingdom Atomic Energy Establishment, Winfrith, Eng.). J. Nucl. Mater.; 49: No. 1, 45-56(Nov 1973).

A review is presented of measurements and evaluations of the specific heat at constant pressure for graphites in the temperature range 200 to 3500°K. A polynomial fit to the data is made for use with nuclear graphite, valid over the range 250 to 3000°K. Some consideration is given to the difference between the specific heat at constant volume and at constant pressure. A measurement of the graphite phonon frequency spectrum at 1800°K is used to calculate the specific heat at constant volume, and then to modify the polynomial fit to the constant pressure data. (7 tables, 3 figures, 43 references) (auth)

16383 DYNAMICAL STATE OF DISLOCATIONS IN GERMANIUM CRYSTALS DURING DEFORMATION. Sumino, K. (Tohoku Univ., Sendai); Kodaka, S.; Kojima, K. I. Mater. Sci. Eng., 13: 263-268(1974).

Experimental results in the strain-rate change tests on germanium single crystals done in a previous paper (Crys. Latt. Defects, 2:159(1971)) are analyzed with the use of new velocity data for isolated dislocations. An equilibrium stationary state of moving dislocations appears in the deformation stage beyond the middle of stage 0 of the stress–strain curve. The velocity $\bar{v}$ and the density N_m of moving dislocations in the equilibrium state are observed to depend on the strain rate $\dot{\epsilon}$ as $\bar{v} \propto \dot{\epsilon}^{0.42}$ and $N_m \propto \dot{\epsilon}^{0.53}$, respectively, at 600°C. Transition of the state of dislocation motion from one equilibrium state to another by a sudden change of the strain rate during deformation is also investigated. It is concluded that the values of $\bar{v}$ and N_m in the equilibrium state at a certain temperature are determined completely by the strain rate and do not depend on the density of total dislocations in the crystal nor on the values of $\bar{v}$ and N_m which the crystal has assumed previously. A transient stage of about 0.5% in strain is found to exist when the state of dislocation motion is transferred from one equilibrium state to another by the change of strain rate. (7 figures) (auth)

16384 EFFECT OF THE IRRADIATION FROM A Ra–α–Be SOURCE ON THE LINEAR EXPANSION TEMPERATURE COEFFICIENT OF SOLID SOLUTIONS OF THE KCl–KBr SYSTEM. Ivankina, M. S. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 14-16(1973). (In Russian).

Measurements were made of the temperature coefficient of linear expansion of monocrystals of the solid solution of the KCl–KBr system irradiated with an isodose. The composition and irradiation dose were varied. Results showed that the thermal properties of the solid solution, that is crystals with reduced bonds in comparison with initial component crystals, can be improved under the effects of irradiation. Crystals with reduced bonds between the ions appear to be the most radiation-stable. (JSR)

16385 VARIATION OF THE ION CONDUCTIVITY OF KCl CRYSTALS UNDER IRRADIATION BY X RAYS AND A HIGH-POWER NANOSECOND ELECTRON BEAM. Matlis, S. B.; Vaisburd, D. I. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 137-139(1973). (In Russian).

The kinetics of the change of the number of cation vacancies under the influence of x rays in KCl crystals with bivalent metallic impurities and purified KCl crystals. The dependence of the electric conductivity of both crystals on the duration of the irradiation with x rays and on the temperature was determined. Irradiation of the crystals with a single pulse of an electron beam (0.3 MeV and 12-ns pulse length with beam density of 1.7×10^{20} electrons/cm^2 sec) led to reduction of the conductivity. (JSR)

16386 RADIATION DESTRUCTION OF F CENTERS IN WHISKERS OF KCl AND KBr. Melik-Gaikazyan, I. Ya.; Lazareva, N. I.; Bydtaev, B. G.; Deryabin, P. E.; Arinshtein, M. M. (Kuzbas Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 139-141(1973). (In Russian).

A study was made to explain the characteristics of the destruction of F centers in whiskers of alkali metal halide compounds in dependence on their dimensions. The kinetics of the destruction of the F centers were determined. The temperature dependence of the logarithm of the ion conductivity was shown. The effect of the scale factor on the rate of radiation accumulation of absorption bands was determined. (JSR)

16387 EFFECT OF PLASTIC DEFORMATION ON THE THERMOLUMINESCENCE OF LiF (TLD-100) SINGLE CRYSTALS. Srinivasan, M.; De Werd, L. A. (Univ. of Washington, Seattle). J. Phys., D (London); 6: No. 17, 2142-2149(15 Nov 1973).

The thermoluminescent properties of LiF (TLD-100) were investigated as a function of plastic deformation. Without exposure to ionizing radiation, plastic deformation up to fracture does not induce a thermoluminescent response. After subsequent exposure to ionizing radiation, the intensity of the thermoluminescent glow peaks decreases with the amount of plastic deformation. This is explained in terms of a relative decrease in the concentration of free dipoles and low-order dipole complexes which act as trapping centres for peaks 2 and

5. This decrease is a result of an interaction of these defect structures with the dislocations introduced during deformation. (auth)

16388 CROSS-SECTIONS FOR THE CREATION OF DAMAGE. Lott, M. (CEN, Fontenay-aux-Roses, France); Genthon, J. P.; Gervaise, F.; Mas, P.; Mougniot, J. C.; Nguyen Van Doan. pp 89-126 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

Differential cross sections representing the rate of creation of damage are established; with these it is possible to calculate the simplest quantities associated with irradiation—i.e., the energy imparted to the material in the form of elastic collisions and the number of displacements per atom. The data necessary for calculating these damage functions are: (a) the neutron cross sections (elastic and inelastic) with their angular distributions; with these it is possible to calculate the spectrum of the (primary) recoil atoms associated with a neutron collision; (b) the energy given up and the number of atoms displaced by the primary atom, which are calculated by means of Lindhardt's universal curve, the results of which are compared with those of a collision-by-collision calculation of the displacement cone. The ARTUS and SOURCE codes are used in calculating with these data the energy imparted to the lattice and the number of displacements per atom. ARTUS X is linked with the UKNDF file. Results are given for all usual cases of common metals and steel. The cross sections necessary for calculating rates of creation of gas (H and He) in irradiated metals are reviewed. (auth)

16389 CALCULATION OF THE ANNEALING RATE OF RADIATION DEFECTS IN SOLID CATALYSTS. Vinetskii, V. L.; Sokol'skii, D. V.; Nadykto, B. T.; Kel'man, I. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 72-76(1973). (In Russian).

The rate of annihilation of point-charge defects in radiation-modified solid catalysts was calculated. The problem was solved on the basis of the Antonov-Romanovskii model using the Montroll approximation method. (tr-auth)

16390 LAYER COMPOUNDS. Yoffe, A. D. (Cambridge Univ., Eng.). Annu. Rev. Mater. Sci.; 3: 147-170(1973).

Properties of layer-type transition-metal dichalcogenides are examined. Discussions are included on structure and optical properties, band scheme for MoS_2, supporting evidence for band structure, thickness effects on excitons, excitonic insulators, properties of intercalated solids, superconductivity, phonon energies, and other solids with layer structures. (72 references) (JRD)

16391 ATOMIC AND IONIC TRANSPORT IN IONIC CRYSTALS. Lidiard, A. B. (Atomic Energy Research Establishment, Harwell, Eng.). (1973). vp.

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

The ideas and theoretical methods used to describe atomic transport in crystalline solids are surveyed. Both kinetic and atomic aspects of the theory are reviewed, but attention is particularly drawn to the value of atomistic calculations of the properties of point defects as guides to the interpretation of experiments and to the most relevant models for evaluation by statistical and kinetic theories. This is illustrated by detailed results on (i) Schottky and Frenkel defect formation energies in alkali halides, alkaline earth fluorides MgO, and UO_2, (ii) the migration energies of rare gas atoms in ionic crystals, especially in the two phases of CsCl, and (iii) the structure of interstitial anion defects in CaF_2 doped with trivalent cations and in non-stoichiometric UO_{2+x}. (GE)

16392 POLYMER-IMPREGNATED CONCRETE COMPOSITES. Hills, P. R. (Atomic Energy Research Establishment, Harwell, Eng.). Rep. Progr. Appl. Chem.; 57: 691-704(1972).

An introduction describes the development and properties of new composite materials prepared by impregnation of porous substrates with monomers, which are subsequently polymerized in situ by high-energy radiation. The review is restricted to an appraisal of polymer concrete composites. Succeeding sections are entitled: theoretical aspects; classification of polymer concrete materials; polymer impregnated composites (monomer selection, polymerization processes, the impregnation process, properties); premixed polymer concretes; polymer-bound aggregates; comparisons with other materials; applications (desalination plant, bridge decking and motorway structures, underwater structures, housing applications, and concrete pipes). (UK)

16393 INVESTIGATIONS OF THE NEUTRON-INDUCED RADIATION DAMAGE IN ALKALI METAL HALIDES. Beutin, B.; Felix, F. W.; Meier, K.; Mueller, M. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). (1973). vp. (In German).

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

Based on previous measurements it has been shown that rare gas atoms produced by a n,p reaction in alkali metal halide crystals will interact with defects in the host lattice. The mobility of rare gas atoms is, therefore, an easily measurable parameter in degassing experiments to determine lattice defects. This is valid for both chemically and neutron-induced defects. Defects occurring in K and Rb halides and in CsCl after in-pile irradiation are discussed. In K and Rb halides, an increase in defect concentration proportional to the dose has been observed after irradiation with doses above about 10^{16} n/cm^2. CsCl has been investigated to determine whether these defects will survive the phase transformation at 470°C from the CsCl to NaCl structure. The results indicate that the defects observed are not point defects. (GE)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 15435.

16394 (COS-4) SAMPLING OF STORES FOR SAFEGUARDS PURPOSES. Brown, F.; Good, P. T.; Parker, J. B. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). [nd]. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The confirmation of management statements regarding the amount of nuclear material in stores has been accepted for some time as being one of the important functions of the safeguards inspector. The size of samples required for various inspection intensities is examined. The inspection of stores containing nuclear material in different forms, e.g., Pu and 93% ^{235}U or in units of different sizes is also included. This report is also available as COS-4A which has some mathematical changes and extended data on sample sizes. (TFD)

16395 (COS-4-A) SAMPLING OF STORES FOR SAFEGUARDS PURPOSES. Brown, F.; Good, P. T.; Parker, J. B. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Jun 1970. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The confirmation of management statements regarding the amount of nuclear material in stores has been accepted for some time as being one of the important functions of the safeguards inspector. The size of samples required for various inspection intensities is examined. The inspection of stores containing nuclear material in different forms, e.g., Pu and 93% ^{235}U or in units of different sizes also is included. This report is a reprint of COS-4 and contains some mathematical changes and extended data on sample sizes. (TFD)

16396 (COS-14) APPLICATION OF SAFEGUARDS TECHNIQUES TO A LARGE ZERO-ENERGY FAST REACTOR FACILITY. Brown, F.; Terrey, D. R.; Good, P. T.; Ross, A. E.; Lumetti, A.; Otomo, T.; Sultan, M.; Kerr, E. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment; International Atomic Energy Agency, Vienna (Austria)). [nd]. 16p. (CONF-700701-8; SM-133-69). Dep. NTIS (U. S. Sales Only) $3.00.

From IAEA symposium on progress in safeguards techniques; Karlsruhe, Federal Republic of Germany (6 Jul 1970).

In collaboration with the UKAEA, the Department of Safeguards and Inspection of the IAEA has carried out experiments to study the use of statistical sampling techniques and nondestructive methods of measurement which may be of value for safeguards purposes. The studies reported, which are part of a continuing program, were carried out at the ZEBRA zero-energy fast reactor facility at AEE Winfrith. The fuel inventory at Zebra consists of a large number ($\sim 10^4$) of small plates of plutonium metal and of mixed plutonium–uranium dioxide. There are thirteen different types of plates, most of which are two inches square, clad with stainless steel. There are also some pins, of three types, containing mixed plutonium–uranium dioxide. The experience gained has clarified the problems inherent in safeguarding the fuel inventory of large zero-energy experimental reactor facilities. The results obtained can be used to formulate procedures for the inspection of other facilities of this type. (auth)

16397 (COS-15) APPLICATION OF INSTRUMENTAL METHODS TO THE DETERMINATION OF NUCLEAR FUEL MATERIALS FOR SAFEGUARDS. Brown, F.; Terrey, D. R.; Hornsby, J. B.; Monk, R. G.; Morgan, F.; Herrington, J.; Good, P. T.; Steed, K. C.; Sinclair, V. M. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). [nd]. 26p. (CONF-700701-9; SM-133-70). Dep. NTIS (U. S. Sales Only) $3.50.

From IAEA symposium on progress in safeguards techniques; Karlsruhe, Federal Republic of Germany (6 Jul 1970).

Developments in instrumental and nondestructive methods for safeguards inspection at UKAEA are summarized. Topics include delayed neutron counting following fast fission, gamma absorptiometry, coulometry, fission neutron counting, and gamma spectrometry. (WHK)

For abstracts of individual papers see: 16568 and 16714.

16398 (COS-16) CRITERIA FOR THE DESIGN OF NUCLEAR INSTALLATIONS TO FACILITATE THE APPLICATION OF SAFEGUARDS. Brown, F.; Coles, R. F.; Ellingsen, J. E.; Golder, J. A.; Goodwin, C.; Janisch, D. B. B.; Morgan, F.; Ross, A. E. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). [nd]. 6p. (CONF-700701-10; SM-133-71). Dep. NTIS (U. S. Sales Only) $3.00.

From IAEA symposium on progress in safeguards techniques; Karlsruhe, Federal Republic of Germany (6 Jul 1970).

IAEA panel meetings on safeguards and reports of the consultants employed by the Agency advocated that work should be carried out on the formulation of features in plant design which would facilitate the operation of safeguards inspections. The lines along which the work is proceeding are discussed. (TFD)

16399 (GEAP-12114-8) JOINT PLANT INSTRUMENTATION PROGRAM AND INTEGRATED SAFEGUARDS EXPERIMENT. Final Report. Wadekamper, D. C.; Bishop, D. M.; Hagie, L. T. (comps.). (General Electric Co., San Jose, Calif. (USA). Nuclear Fuels Dept.). Jun 1972. Contract AT(30-1)-68. 26p. (BHO-68-8). Dep. NTIS $4.00.

Mixed (uranium-plutonium) oxide standards were prepared and utilized to qualify available nondestructive assay equipment (gamma spectrometers, neutron counters, and calorimeters). Equipment was evaluated during normal operation in a plutonium facility. Measured material balances were calculated for two separate fabrication campaigns. Plutonium material unaccounted for values of less than 0.5% based on the total throughput was obtained in the final balance. A special test was undertaken to compare the plutonium content of single pellets determined by available nondestructive assay methods with controlled potential coulometric values. The implications of both programs on safeguards are summarized. (auth)

16400 (LA-UR-73-1657) ^{235}U ENRICHMENT DETERMINATION USING ^{4}He PROPORTIONAL COUNTERS. Caldwell, J. T.; Evans, J. L.; Fehlau, P. E.; Whittlesey, T. H. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 18p. (CONF-731101-43). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Two independent techniques—one passive and one active—for determining ^{235}U enrichment in UF_6 have been developed utilizing ^{4}He proportional counters. Enrichment value precisions with both techniques on the order of 3- to 5-% have been demonstrated during three field trials at the Oak Ridge and Goodyear Atomic Gaseous Diffusion Plants. With the prototype system used during field trials statistical precisions of better than 2% were obtained for typical type 30 and 48 UF_6 cylinders in count periods of 300 seconds or less for both techniques. The same portable electronics package and ^{4}He counter system are used for both techniques. The principle of the active technique is that of thermal neutron-induced fission of ^{235}U followed by fast prompt neutron detection. (auth)

16401 (REG/G-5.9(6-73)) SPECIFICATIONS FOR Ge(Li) SPECTROSCOPY SYSTEMS FOR MATERIAL PROTECTION MEASUREMENTS. Part I. Data Acquisition Systems. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jun 1973. 8p. DRS.

This guide defines and details the specifications for gamma ray spectroscopy data acquisition systems appropriate for special nuclear material assay. (TFD)

16402 (REG/G-5.12(11-73)) GENERAL USE OF LOCKS IN THE PROTECTION AND CONTROL OF FACILITIES AND SPECIAL NUCLEAR MATERIALS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Nov 1973. 5p. DRS.

This guide provides criteria acceptable to the Regulatory Staff for the selection and use of commercially available locks in the protection of facilities and special nuclear materials. (TFD)

16403 (REG/G-5.15(1-74)) SECURITY SEALS FOR THE PROTECTION AND CONTROL OF SPECIAL NUCLEAR MATERIAL. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jan 1974. 6p. DRS.

This guide identifies features of security seal systems and describes types of seals that are generally acceptable to the USAEC Regulatory staff for tamper-safing of special nuclear materials (SNM) in shipment or storage. (TFD)

16404 IAEA SAFEGUARDS IN CONNECTION WITH NPT AND THE IAEA-EURATOM SAFEGUARDS AGREEMENT. Stein, R. M. (International Atomic Energy Agency, Vienna). (1973). vp.

From 1st international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The historical development of the IAEA Safeguards is reviewed. The IAEA-EURATOM Agreement is described and its most essential features such as the right for inspection are discussed. (GE)

16405 ROLE OF NUCLEAR DATA IN NUCLEAR MATERIAL SAFEGUARDS. Weitkamp, C. (Gesellschaft fuer Kernforschung,

Karlsruhe, Ger.); von Baeckmann, A.; Boehnel, K.; Kuechle, M.; Koch, L. pp 197-216 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302- (Vol. 1).

For the timely detection of a diversion of fissionable material from the nuclear fuel cycle the safeguards system uses material balances based on measurements of material flow and inventory. In addition to classical analytical techniques, various nuclear methods have been developed for this purpose. The general procedure for most of these methods consists in the determination of the mass of the fissile specimen relative to a known standard. The way in which nuclear data are required for the development or efficient use of the methods can be divided into four categories. (A) The very feasibility of the method or its development depends upon data insufficiently known. (B) Data are directly needed for the conversion of measured values into material mass; no standard specimens are used. (C) The use of a sufficiently large set of standards is impossible or impractical; therefore nuclear data are needed for calibration or interpolation. (D) The use of standards provides full calibration possibilities, or existing data are adequate. For purposes of illustration a few methods are discussed. An extreme example for category A is gamma resonance fluorescence where the accuracy required for the level and transition energies is far beyond present-day capabilities. Calorimetry and α-spectrometry are directly based upon half-lives and energies some of which are inadequately known (case B). Typical methods for which the number of standards can be greatly reduced by calculation are neutron coincidence determination of plutonium, all techniques that use thermal neutron interrogation and different kinds of activation analysis; some of the required nuclear data need improvement (case C). Passive γ-assay and fast-neutron interrogation belong to category D. Spent fuel is generally not amenable to direct measurement of fissile material content. Here isotope correlations as now determined empirically for a number of thermal reactors and within the burn-up range presently obtainable lend themselves to the indirect determination of burn-up parameters including fissile material content. This correlation technique has proved remarkably universal. An extended general application requires quantitative theoretical explanation which is only possible if the integral neutron reaction cross-sections of heavy isotopes and selected fission products are improved. (auth)

16406 NEW TECHNIQUE FOR ^{235}U ENRICHMENT DETERMINATION IN UF_6 CYLINDERS. Caldwell, J. T. Nucl. Mater. Manage.; 11: No. 11, 16-20(Sum 1973). (LA-UR-73-841).

From 15th INMM annual meeting, 1974; Atlanta, GA (19 Jun 1974).

A new technique for the determination of ^{235}U enrichment in UF_6 cylinders has been developed and demonstrated in two field trails at GAT and ORGDP. The technique is based on thermal neutron induced fission of ^{235}U followed by fast neutron detection of the ensuing prompt fission neutrons. The apparatus required for this technique is intrinsically portable and consists of a (1 to 5) $\times 10^5$ per sec $^{238}PuLi$ or $^{241}AmLi$ neutron source, and high pressure ^4He proportional counters with associated portable counting electronics. Net induced fission neutron counts of better than 2% statistical accuracy can be obtained with ≤ 5 min count times for typical enrichments in 30- and 48-in. dia UF_6 cylinders. With proper calibration typical enrichment accuracies of better than 5% are obtained. The technique can be applied easily and successfully in gross gamma backgrounds of 50 mR/h and in neutron backgrounds associated with closely stacked UF_6 cylinders. (auth)

Disposal and Storage

Refer also to abstracts 15425, 15436, 15569, 15596, 15615, 15633, 15648, 15657, and 17693.

16407 (BNL-18351) RADIOACTIVE SAFETY ASPECTS OF WASTE MANAGEMENT. Hull, A. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 21p. (CONF-731127-2). Dep. NTIS $3.25.

From meeting on radiological and environmental protection; Lima, Peru (19 Nov 1973).

A general review of safety aspects of various waste management practices is presented. The methods include dilute and disperse, delay and decay, and concentrate and contain. Radioactive gases and liquids released from selected U. S. nuclear power plants during 1972 are presented in tabular form. (TFD)

16408 (CONF-731120-1) RADIOACTIVE WASTE SYSTEMS AND RADIOACTIVE EFFLUENTS. Row, T. H. (Oak Ridge National Lab., Tenn. (USA)). 1973. 14p. Dep. NTIS $3.00.

From environmental impact statements or nuclear power plants meeting; Atlanta, Georgia, USA (26 Nov 1973).

Radioactive waste systems for handling gaseous, liquid, and solid wastes generated at light and pressurized water reactors are described. (TFD)

16409 (DPSPU-59-11-16) RADIOACTIVITY IN R-AREA SEEPAGE BASIN SYSTEM. Horton, J. H.; Mealing, H. G. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Plant). Jul 1959. 9p. Dep. NTIS $3.00.

Use of seepage basins for the disposal of liquid radioactive wastes at the Savannah River Plant has been limited because of the generally unfavorable geological and climatic conditions. As of June 1958 the Separations Areas had discharged only 3 Ci of alpha emitters, 270 Ci of nonvolatile beta emitters, and 2300 Ci of radioiodine to seepage basins. Except for R Area, the discharge of radioactive liquid wastes to seepage basins by the reactor areas had totaled less than 100 Ci of nonvolatile beta emitters as of June 1958. The rupture of an experimental fuel element in a section of the R-Area disassembly basin during Nov. 1957 resulted in the discharge of approximately 2700 Ci of nonvolatile beta to six seepage basins. This report presents data obtained from the monitoring of these basins and the surrounding ground water, and correlates these data with the geology and hydrology of the area. The period covered is from Nov. 1957 to Nov. 1958. (auth)

16410 (IDO-10052) NRTS RADIOACTIVE WASTE MANAGEMENT INFORMATION FOR 1971. (USAEC Idaho Operations Office, Idaho Falls). 1973. 155p. Dep. NTIS $9.75.

A computerized Waste Management Information System (WMIS) has been utilized at the National Reactor Testing Station (NRTS), Idaho, since January 1971. This system serves as the official record of all types of radioactive wastes stored or disposed at the NRTS. The system standardizes the reporting of all forms and types of wastes disposed or stored at the NRTS. It permits a more timely reporting of materials stored or released to the environment at the NRTS. At the same time, computerization of this data provides considerable flexibility in making various data readily available from a single data base. Contractors from AEC Operations Offices routinely report information on airborne, liquid, and solid radioactive material stored or disposed at the NRTS. A computer printout of waste storage and disposal activities for 1971 is presented. (TFD)

16411 (IDO-10053) NRTS RADIOACTIVE WASTE MANAGEMENT INFORMATION FOR 1972. (USAEC Idaho Operations Office, Idaho Falls). 1973. 154p. Dep. NTIS $9.75.

A computerized Waste Management Information System (WMIS) has been utilized at the National Reactor Testing Station (NRTS), Idaho, since January 1971. This system serves as the official record of all types of radioactive wastes stored or disposed at the NRTS. The system standardizes the reporting of all forms and types of wastes disposed or stored at the NRTS. It permits a more timely reporting of materials stored or released to the environment at the NRTS. At the same time, computerization of this data provides considerable flexibility in making various data readily available from a single data base. Contractors from AEC Operations Offices routinely report information on airborne, liquid, and solid radioactive material stored or disposed at the NRTS. A computer printout of waste storage and disposal activities for 1972 is presented. (TFD)

16412 (N-73-21562) STUDY OF EXTRATERRESTRIAL DISPOSAL OF RADIOACTIVE WASTES. Part 3. Preliminary Feasibility Screening Study of Space Disposal of the Actinide Radioactive Wastes with 1 Percent and 0.1 Percent Fission Product Contamination. Hyland, R. E.; Wohl, M. L.; Finnegan, P. M. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1973. 41p. (NASA-TM-X-68216). NTIS $4.25.

A preliminary study was conducted of the feasibility of space disposal of the actinide class of radioactive waste material. This waste was assumed to contain 1 and 0.1% residual fission products, since it may not be feasible to completely separate the actinides. The actinides are a small fraction of the total waste but they remain radioactive much longer than the other wastes and must be isolated from human encounter for tens of thousands of years. Results indicate that space disposal is promising but more study is required, particularly in the area of safety. The minimum cost of space transportation would increase the consumer electric utility bill by the order of 1% for earth escape and 3% for solar escape. The waste package in this phase of the study was designed for normal operating conditions only; the design of next phase of the study will include provisions for accident safety. The number of shuttle

launches per year required to dispose of all U. S. generated actinide waste with 0.1% residual fission products varies between 3 and 15 in 1985 and between 25 and 110 by 2000. The lower values assume earth escape (solar orbit) and the higher values are for escape from the solar system. (auth)

16413 (N-73-21563) SPACE TRANSPORTATION AND DESTINATION CONSIDERATIONS FOR EXTRATERRESTRIAL DISPOSAL OF RADIOACTIVE WASTE. Zimmerman, A. V.; Thompson, R. L.; Lubick, R. J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1973. 41p. (NASA-TM-X-68211). NTIS $4.25.

A feasibility study is summarized of extraterrestrial disposal of radioactive waste. The initial work on the evaluation and comparison of possible space destinations and launch vehicles is reported. Only current or planned space transportation systems were considered. The currently planned space shuttle was found to be more cost effective than current expendable launch vehicles, by about a factor of two. The space shuttle will require a third stage to perform the disposal missions. Depending on the particular mission this could be either a reusable space tug or an expendable stage such as a Centaur. Of the destinations considered, high earth orbits (between geostationary and lunar orbit altitudes), solar orbits (such as a 0.90 AU circular solar orbit) or a direct injection to solar system escape appear to be the best candidates. Both earth orbits and solar orbits have uncertainties regarding orbit stability and waste package integrity for times on the order of a million years. (auth)

16414 (ORNL-TM-4449) STORAGE AND RELEASE OF RADIATION ENERGY IN SALT IN RADIOACTIVE-WASTE REPOSITORIES. Jenks, G. H.; Bopp, C. D. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 82p. Dep. NTIS $6.25.

The use of bedded salt formations for the disposal of radioactive wastes has been developed and demonstrated in the Carey Salt Company mine at Lyons, Kansas. One of the questions that has been raised with respect to the suitability of this concept is whether any stored energy which might be accumulated in the salt due to gamma radiation could be released in such a manner as to cause serious thermal excursions or other undesirable effects. Results of experimental efforts to determine the potential hazards from this disposal method are reported. (TFD)

16415 (REG/G-3.11(6-73)) DESIGN STABILITY OF EMBANKMENT RETENTION SYSTEMS FOR URANIUM MILLS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jun 1973. 2p. DRS.

The milling of uranium ore results in the production of large volumes of liquid and solid wastes (tailings). Confinement of these wastes is usually accomplished by the construction of an embankment retention system. This guide specifies acceptable methods for analyzing the stability of embankments, minimum acceptable safety factors that are applicable during construction and use of embankment systems, and acceptable surveillance procedures. (TFD)

16416 (REG/G-3.13(10-73)) GUIDE FOR ACCEPTABLE WASTE STORAGE METHODS AT UF_6 PRODUCTION PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Oct 1973. 2p. DRS Washington, DC Free.

This guide describes design criteria acceptable to the USAEC Regulatory staff for the safe storage of liquid and solid radioactive wastes from plants producing UF_6 from uranium mill concentrates. (TFD)

16417 (RT/PROT-(73)24) MAXIMUM VERTICAL DISPLACEMENT OF SEA LEVEL OF THE TARANTO REGION DURING THE LAST 125,000 YEARS AND THE OUTLOOK FOR THE GEOLOGIC DESTINATION OF WASTES CONTAINING TRANSURANIC ELEMENTS. Dai Pra, G.; Magri, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1973. 5p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.00.

Dating of a coral sample using the $^{230}Th/^{234}U$ method has demonstrated that about 125,000 years ago the sea level was situated at an elevation of between 21 and 35 m above the present sea level. Taking into account that from 13 to 14,000 years ago the sea level was located about 100 m below the present level, it follows that in about 110,000 years a sea level drop of over 120 m occurred with respect to the continent. The information gathered represents a contribution to the estimation of the maximum geological change reasonably foreseeable; this knowledge is necessary to insure the geological isolation of possible long-lived alpha emitting radioactive waste, chiefly ^{239}Pu. (auth)

16418 STRATEGY FOR POLLUTION CONTROL IN NUCLEAR INDUSTRY. Amalraj, R. V.; Sirish, H. N.; Thomas, K. T. (Bhabha Atomic Research Centre, Bombay). Indian J. Occup. Health; 15: No. 6, 12-17(Jun 1972).

The practice followed by the nuclear industry for controlling industrial wastes owing to the unique characteristics of the radionuclides present in the waste products is highlighted. The magnitude of the waste disposal problem in the nuclear industry is envisaged. The three most general principles of radioactive waste management (concentrate and consume, dilute and disperse, and delay and decay) are discussed. The three successful engineering processes, i.e., chemical treatment, ion exchange, and evaporation are described as a solution to the problem of waste management for some of the liquid wastes in concentrated form. Based on safety and economic considerations for the conditions prevailing at a particular site, the three modes of disposal, i.e., fresh water disposal, marine water disposal, and ground disposal are recommended. (INIS)

16419 GENERAL PRINCIPLES CONCERNING REGULATION OF CONDITIONS OF DISCHARGE OF LIQUID, GASEOUS, AND SOLID RADIOACTIVE WASTES. Cantillon, G. E. (Inst. of Hygiene and Epidemiology, Brussels). J. Belge Radiol.; 56: No. 5, 435-438(1973). (In French).

The fundamental rules developed by international radiation protection organizations are mentioned; then, the way those recommendations are applied to liquid, solid, and gaseous effluents, in the Belgian legislation, is described. (auth)

16420 STUDY OF LONG-TERM HEAT GENERATION IN NUCLEAR BY-PRODUCTS FROM LWR AND LMFBR SYSTEMS. Angelo, J. A. Jr.; Post, R. G.; Haskin, F. E.; Lewis, C. (Univ. of Arizona, Tucson). pp 71-88 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

Thermal outputs of high-level radioactive by-products from both a 1000-MW(e) reference LWR and a 1000-MW(e) reference LMFBR were calculated for cooling times ranging from one year to 1000 y. Both graphical and tabular representations of the data are useful in a wide variety of long-range by-product management studies. A relatively fast and simple computer code, RADEC, was developed to perform the bulk of the computations. Excellent agreement was obtained with the more extensive ORIGEN code developed at Oak Ridge National Laboratory. In-core effects of fission product transmutation and actinide element build-up were included in the computations and were found to be significant. The former effect can account for as much as 25% of the by-product afterheat during the first decade of cooling primarily due to the production of ^{134}Cs in neutron absorption by the fairly abundant fission product ^{133}Cs. Heat generation rates for LWR and LMFBR by-products are comparable during the first century of cooling but diverge rapidly thereafter with the actinide elements predominating after 120 y for the LMFBR and after 225 y for the LWR. Detailed, time-dependent analyses of the more thermally significant fission products and actinide elements were calculated and plotted. (auth)

16421 NUCLEAR DATA FOR SHIELDING AND ACTIVATION ESTIMATES FOR TRIUMF. Thorson, I. M.; Wiesehahn, W. J. (Simon Fraser Univ., Burnaby, B. C.). pp 595-606 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

The more important radiation transport and residual activity production estimates required for the high-intensity (100 μA) medium-energy (500 MeV), H^- isochronous cyclotron, external beam lines and targets of TRIUMF are enumerated and discussed. The gross features of the radiation field distribution during operation of the facility are primarily dependent on the hadronic cascade in the facility components and shields. Lacking adequate experimental data for the secondary particle spectra and angular distributions, almost exclusive reliance has been placed on the results from intra-nuclear cascade calculations. The residual activation and radiation field problems, which are more comparable in intensity to those found at fission reactors than previous generations of accelerator facilities, are complicated by the wide variety of product species from high-energy hadron reactions. The available experimental data are at best incomplete and often fragmentary. Extensive reliance for nuclear data requirements has been placed on compilations based on Rudstam's empirical formula; more recently activity production estimates based on Silberberg and Tsao's extended empirical formula have been used. (auth)

Handling Equipment and Procedures

Refer also to abstracts 15253, 15506, 15785, and 15801.

16422 (AWRE-O-58-73) MEASUREMENT OF THE CRITICAL SIZE OF SOLUTIONS OF PLUTONIUM AND NATURAL URANIUM NITRATES WITH Pu/U = 0.3. Lane, R. C.; Parker, C. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Dec 1973. 40p. Dep. NTIS (U. S. Sales Only) $4.00. UK £1.00.

An account is given of an experimental investigation of the critical size and other reactivity parameters of mixtures of plutonium and natural uranium having a plutonium content of ~30%. Measurements of the critical size, neutron spectrum and prompt decay constant of a mixture of PuO_2 and UO_2 density of 1 g (Pu)/liter, moderated by polythene to give H/Pu = 18.6 have been reported (Lane, et al., AWRE Report O 32/68; and Paterson, et al., SM 101/40, IAEA (1967)). The critical size measurements are extended to essentially thermal cores which are more conveniently studied using solutions of the fissile isotopes in nitric acid. Four concentrations of fissile solution were used: 330 g (Pu + U/liter), 32, 18.6 and 17.5 g (Pu)/liter respectively. A diagram is shown of SCAMP (Solution Criticality Assembly Machine – Plutonium), which consists essentially of a means of remotely filling a cylindrical core vessel with fissile solution under controlled conditions, with facilities for rapid dump of the solution in case of an unexpected reactivity increase. The core vessel is reflected with effectively infinite water, the removal of which provides a secondary reactivity shut-down mechanism. This apparatus, together with the necessary storage vessels, pumps and other ancillary equipment, is mounted within two interconnecting glove boxes. These are constructed from fiber glass panels moulded to steel frames. Details of the equipment, of the experimental method, and of the results are presented. (UK)

16423 (GKSS-73-E-22) FULLY AUTOMATIC INSTALLATION FOR NOTCH IMPACT BENDING TESTS OF RADIOACTIVE SPECIMENS IN THE TEMPERATURE RANGE −160°C TO +200°C. Hebenbrock, H. D.; Timms, H. H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1973. 21p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

The construction and operation of an automatic refueling system for a commercial 30 kpm impact testing machine are described. This installation is employed for the testing of irradiated radioactive ISO-V-specimens (preferably steel and cast iron). (GE)

16424 (ISO-158) FLOWSHEETS FOR HOOD 4 LABORATORY-TYPE HOOD. Bruns, L. E. (Isochem Inc., Richland, Wash. (USA)). 14 Mar 1966. Contract AT(45-1)-2130. 22p. Dep. NTIS $3.25.

Hood 4 is a new hood in the Plutonium Reclamation Facility miscellaneous treatment room. Construction on the original design was completed during February, 1966. Initial usage was delayed pending review of necessary additional fixed equipment. Hood 4 is designated as the miscellaneous treatment specialty hood. It has space for glass dissolvers and/or other movable processing equipment. It has a section that can be nitrogen-purged for processing such things as PV lids (containing highly reactive calcium). Hood 4 originally contained only a receiver tank and a vacuum trap tank as fixed equipment. Review of the type material that may be processed in hood 4 led to further fixed equipment recommendations. A filter feed tank and pan filter will be installed to aid in processing such things as ash solids. Three fixed condensers will be installed in each of the glass dissolver compartments. This will eliminate any danger from pressurizations that could cause serious problems with flimsy glass reflux condensers. The fixed condensers will be housed in kynar to minimize corrosion problems. (auth)

16425 (RD/B/N-2775) ASSESSMENT OF THE PERFORMANCE OF AN EXTENDED SPECFIELD SERIES D2 ENDOSCOPE AND A COMPARISON WITH ALTERNATIVE VIEWING SYSTEMS. Jones, A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

A description of the performance of the extended Specfield series D2 endoscope is given, based on the results of laboratory tests. The endoscope is compared with two alternative viewing systems, briefly with flexible fiber-optics and in particular with a CCTV camera. It is concluded that only CCTV is a serious alternative to the extended endoscope, and may offer superior resolution on the inspected object. However, an example is given of a situation where this advantage cannot be realized in practice. (auth)

16426 (REG/G-5.8(6-73)) DESIGN CONSIDERATIONS FOR MINIMIZING RESIDUAL HOLDUP OF SPECIAL NUCLEAR MATERIAL IN DRYING AND FLUIDIZED BED OPERATIONS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jun 1973. 5p. DRS.

This guide describes acceptable design features and characteristics for minimizing the residual holdup of special nuclear materials (SNM) in drying and fluidized bed operations after shutdown, draindown, or cleanout in order to facilitate material control and accountability procedures. (TFD)

16427 (REG/G-5.15(1-74)) SECURITY SEALS FOR THE PROTECTION AND CONTROL OF SPECIAL NUCLEAR MATERIAL. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1974. 4p. DRS.

This guide identifies features of security seal systems and describes types of seals that are generally acceptable to the Regulatory staff for tamper-safing of special nuclear materials containers. (TFD)

Transportation

Refer also to abstract 17693.

16428 (LCA-NT-228-E-T) RADIOPROTECTION OF A CYLINDRICAL CONTAINER. Warme-Janville, B. (Laboratoire Central de l'Armement, 94 – Arcueil (France). Dept. Detection Protection Nucleaire). 12 Dec 1972. 16p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The radioprotecting properties of cylindrical containers having an internal cavity of 30 × 50 cm were studied. The dose was determined at a distance of 3 meters from the container walls. Results are given for depleted uranium and lead walls. (FR)

16429 SPENT NUCLEAR FUEL SHIPPING CASKS. Kasberg, A. H. (to Atlantic Richfield Co.). US Patent 3,781,189. 25 Dec 1973. Filed Date 7 Jul 1971. 4p.

UH_3-ductile metal cermet is used as a radiation shield in a shipping cask for spent nuclear fuel rods. (Official Gazette)

PARTICLE ACCELERATORS

Design, Development, and Operation

16430 (LA-tr-73-53) STUDY OF THE CHARACTERISTICS OF A LINEAR ACCELERATOR OPERATING IN A TRANSFORMATION-WAVE MODE. Bomko, V. A.; Kliucharev, A. P.; Rudiak, B. I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1972. Translated by A. D. Cernicek from KHFTI-72-44. 15p. Dep. NTIS $3.00.

The method of fine control of the energy of heavy particles accelerated in linear accelerators is used successfully at present in a proton linear accelerator calculated for the maximum energy of 9 MeV (LU-9) and in a linear accelerator of multicharged ions for the maximum energy of 10 MeV per nucleon (LUMZI-10). Its efficiency was shown while in operation and the characteristics of an accelerated particle beam were steadily maintained. Automatization of the energy change process was accomplished and a study of the electrodynamics of the processes taking place in the accelerating cavity operating with energy control was made. Various aspects of field degeneration of wave modes were investigated under the effect of tuning devices and devices for field shaping. Studied in detail were the transformation processes for fields resulting in an increase of the stability of accelerating field distribution as well as the localization of high-frequency power losses. Results of these investigations are reported. This experimental study was made on the proton linear accelerator LU-9. (auth)

16431 (NP-19931) FUTURE OF NEW COLLECTIVE METHODS OF ACCELERATION. Rabinovich, M. S.; Tsytovich, V. N. (AN SSSR, Moscow. Fizicheskij Inst.). 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

A general analysis of the future of different methods of collective acceleration of charged particles proposed by V. I. Veksler is given. (39 references) (auth)

16432 (RL-73-129) NIMROD OPERATION AND DEVELOPMENT QUARTERLY REPORT, APRIL 1–JUNE 30, 1973. Gray, D. E. (ed.). (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

The Nimrod beam was on for high-energy physics research for 80.1% of HEP scheduled operating time. Three experiments commenced and two continued through in the period. Some statistics relating to personal radiation dosimetry are presented. (auth)

16433 TRITIUM TARGET WITH COMPENSATED SPUTTERING. Reifenschweiler, O. (to Philips Corp.). US Patent 3,784,824. 8 Jan 1974. Filed date 18 Dec 1970. 4p.

A neutron generator comprising a vaporizer or an atomizer to vapor-deposit or sputter on the target plate during operation, a layer which consists of a material which cannot take up or takes up very little, hydrogen is described. (Official Gazette)

16434 RADIATION ENVIRONMENT OF HIGH-ENERGY ACCELERATORS. Rindi, A.; Thomas, R. H. (Lawrence Berkeley Lab., CA). Annu. Rev. Nucl. Sci.; 23: 315-346(1973).

Topics include the radiation environment of high-energy proton accelerators, electron accelerators, and accelerators with energies > 10 GeV; radiation protection (dose equivalent, dose equivalent–depth distributions, and conversion factors); shielding (phenomenological models and Monte Carlo calculations); and induced radioactivity (accelerator components and other solids, air and water, and the environmental impact of radioactivity). (155 references) (WHK)

16435 NEW DEVELOPMENTS OF HIGH ENERGY ACCELERATORS IN RECENT YEARS. Hsu, C. M. Wu-li (Inst. of High Energy Physics, Peking). 2: No. 3, 128-149(Aug 1973).

New developments in high energy accelerators since 1966 are reviewed. Subjects covered include strong focusing synchrotrons, medium-high-energy high-current accelerators, colliding-beam accelerators, and new principles and techniques for accelerators. Utilization of computer and automation techniques has been widespread. Current research areas include superconductor magnets and superconductor resonant cavities, electron ring accelerators, and other new principles of accelerators. Superconductor magnet strong focusing synchrotrons of 1000, 2000, 5000 GeV, proton-proton machines of 200 GeV, and an electron-positive electron machine of 15 GeV are discussed. In the area of linear accelerators, under consideration is a 50 to 60-GeV machine based on "return" accelerating systems. Under construction is a 2-GeV electron superconductor linear accelerator. Being planned is a proton superconductor linear accelerator of several thousand GeV. An electron ring accelerator of 10's to 100 GeV is also discussed. (JPRS)

16436 PARTICLE ACCELERATION BY TEMPLATE MODIFIED COHERENT LIGHT. Csonka, P. L. (Univ. of Helsinki). Particle Accel.; 5: No. 3, 129-154(1973).

A method is suggested to accelerate charged particles by intense bursts of monochromatic radiation of wavelength λ. Such radiation can be produced by lasers and is modified by a general optical element called "template" which may be a holograph. Apart from the conventional optical elements all information is in the template, and when that is a holograph, it can be reproduced photographically. No magnets are needed. The ideal particle trajectory is straight and fully parallel to the electric field. Accelerating and focusing field elements have dimensions comparable to λ: high degree of miniaturization results. Assuming cylindrical geometry, a laser producing 10^{14} Watts instantaneous power, and that the limit can be reached when the radial wavelength $\lambda_r \rightarrow \lambda$, the energy of a relativistic particle could be increased by about 180 GeV in 2 meters when the radiation coherence is maintained along the particle orbit. At such accelerations machine length can be reduced, vacuum and beam stability requirements can be relaxed, the beam cross section will tend to shrink, and damping due to synchronized radiation may be significant. Heavy ions and unstable particles can be accelerated, positive and negative particles simultaneously. To reach higher energies, more than one laser are joined by "synchronizers". (auth)

Auxiliaries and Components

16437 (ITEF-29) MEASUREMENT OF THE EMITTANCE OF A BEAM (OF IONS) AT THE OUTLET OF THE LINEAR ACCELERATOR I-2. Batalin, V. A.; Kuibida, R. P.; Sherman, V. E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The measurement of the emittance of an ion beam at the output of the linear accelerator by the two-slit method is described. The focusing and correcting electromagnetic guide device is used for parallel transport and scanning of the beam. The results of the measurement of 180-mamp beam current are reported. (tr-auth)

16438 (NIIEFA-B-174) RESIDUAL FIELD IN SYNCHROTRON SUPERCONDUCTING MAGNETS. Vasil'ev, V. L.; Trokhachev, G. V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 10p. (In Russian). INIS.

A method is proposed for the calculation of the residual fields in the superconducting magnets of the synchrotron, taking into account the distribution of the intensity of the magnetic field within the windings of the superconducting magnet. The results of the calculation of the residual field in the median plane of the working area are reported for three variants of the magnets and a comparison is made with experimental data. (tr-auth)

16439 HIGH-PRECISION QUANTAMETER FOR NAL. Harris, F.; Yount, D. (Univ. of Hawaii, Honolulu). Nucl. Instrum. Methods; 114: No. 2, 357-363(1974).

Specifications and test data are given for a high-precision ionization quantameter to be used at NAL. The gain per GeV is expected to be independent of photon beam energy from 1 to 1000 GeV and to be independent of beam intensity for any practical photon flux that can be produced at NAL during a uniform spill of 1 s duration. Measurements of the quantameter gain with incident electrons at SLAC yield (416.0 ± 0.8) ions/GeV at 10 GeV and (416.1 ± 0.8) ions/GeV at 19.7 GeV for a hydrogen filling, corrected to a standard pressure of 30.00" Hg and temperature of 300°K. The gain is independent of intensity up to about 3×10^7 electrons per cm^2 per 1.5 μs pulse at 10 GeV, and it varies with beam centering by less than 0.1% over a 20-cm diameter. Concurrent tests of a new SLAC quantameter yield (426.2 ± 0.8) ions/GeV at 10 GeV and (426.1 ± 0.8) ions/GeV at 19.7 GeV. The errors given are calculated from fluctuations in various series of integrations; the systematic uncertainties are estimated to be ±1.4 ions/GeV at each point. (auth)

16440 DEVICE FOR BUNCHING THE PARTICLES OF A BEAM, AND LINEAR ACCELERATOR COMPRISING SAID DEVICE. Tronc, D.; Leboutet, H. (to Thomson-CSF). US Patent 3,784,873. 8 Jan 1974. Priority date 31 Oct 1970, France. 4p.

The bunching device is essentially constituted by a cylindrical

cavity resonator, which advantageously replaces the conventional device encountered in linear accelerators, including a velocity-modulation cavity for modulating the particles and a drift space for bunching the particles. The length of this bunching cavity is associated with the velocity of the particles in said cavity and with the operating frequency of the accelerator. A device of this kind, which is of small size and low cost, renders unnecessary the conventional control of amplitude and phase of the signals which are injected into the bunching device and the accelerator structure, which are coupled in a direct manner. Furthermore, it enables operation to be carried out under conditions of heavy current, while achieving good efficiency. (Official Gazette)

16441 MEASUREMENT OF INDUCED RADIOACTIVITY IN MATERIALS FOUND AROUND A NEUTRON GENERATOR. Kocol, H. (Food and Drug Administration, Washington, DC); Plott, W. F.; McNelis, D. N.; Moghissi, A. A. Health Phys.; 26: No. 1, 111-114(Jan 1974).

The induced radioactivity in the construction materials of a Cockcroft–Walton type neutron generator was measured. Major activation products (^{24}Na, ^{28}Al, ^{56}Mn, ^{64}Cu, ^{65}Ni, ^{69m}Zn, ^{88}Rb, ^{91}Sr, ^{101}Mo, ^{187}W) and resulting doses are tabulated. Results show that the highest gamma activities would be observed in the fluorescent bulbs, copper pipe, aluminum lattice rod, and the aluminum pipe clamp. Thermoluminescent dosimeter readings yield the highest doses for the copper pipe tee, copper pipe, and aluminum lattice rod. Results of measurements of the neutron and γ dose profiles of the facility are shown. However the indication is clearly that the tritium target, compared to other components, is the major source of radiation both during and after shutdown. (UK)

Ion Sources and Injection and Extraction Systems

16442 CHARGE-EXCHANGE CELL WITH CESIUM RECYCLING. Bacal, M.; Truc, A.; Doucet, H. J.; Lamain, H.; Chretien, M. (Ecole Polytechnique, Paris). Nucl. Instrum. Methods; 114: No. 2, 407-409(1974).

Capillarity is used to recycle cesium in order to increase considerably the time of service of a cesium charge-exchange cell in an ion source. (auth)

16443 ION SOURCE EMPLOYING A MICROWAVE RESONANT CAVITY. Fremiot, C.; Grando, J. (to Commissariat A l'Energie Atomique). US Patent 3,778,656. 11 Dec 1973. Priority date 29 Jul 1971, France. 8p.

The ion source comprises a plasma source employing a microwave cavity which is excited in one of its modes of resonance and a static magnetic field adjusted to the electron cyclotron resonance, means for extracting the ions from the plasma and comprising an expansion cup pierced by an aperture which communicates with the cavity and ion-extraction electrodes brought to suitable potentials. The density of the plasma is of maximum value in the vicinity of the aperture and the static magnetic field is substantially zero in the vicinity of the extraction electrodes. (Official Gazette)

16444 COMPUTATION OF PIERCE ELECTRODES FOR A RELATIVISTIC HIGH-CURRENT ELECTRON BEAM SOURCE. Dommaschk, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Particle Accel.; 5: No. 3, 171-177(1973).

For an axisymmetric high-current electron beam source with plane field emission cathode accelerating field structures around stationary beams of high quality are computed. This is accomplished in two main steps. In the first step a sufficiently self-consistent mathematical model for the electron flow and electric potential distribution in the region occupied by the beam is given. This model includes self-magnetic fields. It is determined by a system of simultaneous analytic differential equations whose integration yields the shape of the beam border and a corresponding voltage and normal field distribution along this boundary. In the second step the potential is continued from this boundary into the space-charge-free region outside the beam. This involves solving a Cauchy initial value problem for the Laplace equation. Since this equation is elliptic, the problem cannot be solved in a stable manner by a numerical algorithm which works in the real space of the coordinates only. By a method due to Garabedian stable results are obtained, however, in our case by extending the Cauchy data and the computational process for complex values of the coordinates. This computation finally yields a system of equipotential surfaces outside the beam which can practically be achieved as in Pierce systems by correspondingly shaped accelerating electrodes. (auth)

Ion Optics and Field Calculations

16445 QUANTUM THEORY OF ELECTRON MOTION IN A SYNCHROTRON TAKING INTO ACCOUNT AN AUTOPHASING FIELD. I. Wave Functions. Melikyan, R. A.; Orlov, Yu. F.; Kheifets, S. A. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 2, 85-92(1973). (In Russian).

The quantum mechanical motion of particles in an inhomogeneous stationary magnetic field in the presence of travelling autophasing electromagnetic waves was investigated. The wave functions and particle energy eigenvalues were obtained. (auth)

16446 USE OF AN ELECTROSTATIC PARTICLE GUIDE FOR LARGE ANGLE BENDS. Andrew, R. (Salford Univ., Eng.). J. Phys., E (London); 7: No. 1, 61-64(Jan 1974).

A cylindrical electrostatic particle guide incorporating a 90° bend has been constructed and tested. Transmission efficiency and beam profile are investigated for 500 eV electrons and the results suggest that the technique will be particularly suited to low-energy ion beam transport over nonrectilinear trajectories. (auth)

16447 TREATMENT OF FIELD STABILIZATION IN DIELECTRICALLY STEMMED HELICAL LOADED WAVEGUIDES BY A TRANSMISSION LINE MODEL. Herminghaus, H. (Univ., Mainz). Particle Accel.; 5: No. 3, 123-128(1973).

An approximate transmission line theory of the shielded helix is presented that allows the effect of certain discontinuities of the waveguide to be estimated. From this model a method of field stabilization of the TALIX-type sections is derived. The results are experimentally verified. (auth)

Storage Rings

Refer also to abstract 16963.

16448 (BNL-18528) MULTIPARTICLE DETECTOR FOR ISABELLE. Kirz, J. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1973. 6p. Dep. NTIS $3.00.

The proposed multiparticle spectrometer is designed to study particles produced at small angles ($0.5 < \theta < 20$ mr). It is assumed to be part of a larger set-up, where the larger angles are covered by other spectrometers, or at least a 4π detector, such as described by Arnold et al. (CRISP 72-65). The general layout consists of 4 magnets in a symmetrical arrangement. A set of proportional chambers downstream from the first set of magnets can measure both angle and momentum. Using a second pair of magnets, the momenta can be re-combined. Then all tracks will point back to the original interaction point in compact bundle, which may be suitable for particle identification by Cherenkov counters further downstream. (auth)

Experimental Facilities

Refer also to abstracts 15747, 15748, 15755, and 16950.

16449 (AECL-4658) ROLE OF ELECTRICALLY PRODUCED NEUTRONS IN NUCLEAR POWER GENERATION. Fraser, J. S.; Hoffmann, C. R. J.; Tunnicliffe, P. R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1973. 33p. (CONF-730849-3). Dep. NTIS (U. S. Sales Only) $3.75. AECL $1.00.

From summer study group on practical applications of accelerators, Los Alamos, New Mexico, USA (27 Aug 1973).

Currently, operating thermal reactors burn only about 1% of the heavy element content of natural uranium. The long-range future of fission nuclear power will be based on some form of complete utilization of the fertile materials ^{238}U and ^{232}Th which are sufficiently abundant to supply the world's energy needs for the indefinite future. Conversion of fertile to fissile materials in fast breeder or converter reactors requires an inventory or continuing supply of neutrons currently available as ^{235}U. An alternative is electrical production of neutrons by accelerators or fusion devices. The Canada Deuterium Uranium (CANDU) reactor operating on the ^{232}Th–^{233}U cycle is a near-breeder requiring a small continuing supply of neutrons. A spallation neutron source based on a proton linear accelerator may prove economically competitive in a unit size having a 1 GeV beam energy and a beam current ~300 mA. Subject to a demonstration of feasibility, a neutron source based on a laser fusion device might possibly be economic in a smaller unit size. Experiments are under way at Chalk River on the design and operation of high current, low energy accelerators with 100% duty factors. These experimental programs should provide experience and design data pertinent to factory-type accelerators. Presently operating research accelerators will not only supply basic

design for electrical breeding devices, but will also be applied to the acquisition of nuclear data essential to accurate economic assessments. (auth)

16450 (CNEA-353) BUENOS AIRES ISOTOPE-SEPARATOR ON-LINE FACILITY (IALE PROJECT). I. Planning and Initial Experiences. Achterberg, E. O.; de Aisenberg, E. Y.; Iglesias, F. C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 29p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.50.

Experimental equipment to study nuclear properties of short-lived isotopes away from the line of beta stability is described. The main parts are a Cockcroft-Walton accelerator, a mass separator, semiconductor detectors, and a computerized multichannel analyzer system. The whole system works on-line. The results with ^{88,90,91}Kr, ^{137,138,139,140,141}Xe, and ^{134m}I are reported. The radionuclides were obtained in ^{235}U thermal neutron fission. The neutrons were produced by the ^{7}Li(d,n)^{8}Be reaction and thermalized in paraffin. The fission products were swept into the ion-source of a mass separator (double-focalization, Scandinavian type, designed and built at our laboratory) in 1 to 2 seconds by a mixture of rare gas and iodine. Masses were selected at the focal plane of the mass separator with appropriate exit slits and the ions were collected either on a fixed or a moving tape close to Ge(Li) and Si(Li) semiconductor detectors. A computer was used to store the digital spectroscopic information and to perform some of the data processing. The data were processed by conventional computational methods. (auth)

16451 (LA-UR-73-1832) MESON FACTORIES, PI MESON DELIVERY, AND PI MESON DOSIMETRY FOR CANCER THERAPY. Knapp, E. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 9p. (CONF-731123-1). Dep. NTIS $3.00.

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, Illinois, USA (25 Nov 1973).

The meson therapy research program at the Los Alamos Meson Physics Facility (LAMPF) is briefly described. It is stated that tests will start on a magnetic collection channel for pions at LAMPF within one or two months, and the biomedical pion channel is described. The problems encountered in pion dosimetry are briefly discussed. (WDK)

16452 AUTOMATIC MEASUREMENT OF EXCITATION FUNCTIONS BY CONTINUOUS BEAM-ENERGY MODULATION. Wormald, M. R.; Takacs, J. (Nuclear Physics Lab., Oxford). Nucl. Instrum. Methods; 114: No. 2, 263-267(1974).

A general method is described for generating excitation functions with electrostatic accelerators by continuous beam-energy modulation. The method can be more accurate, faster and less tedious than the manual method and avoids systematic errors due to target deterioration. The apparatus required is minimal and may be largely constructed from standard NIM modules. (auth)

16453 FAST, PRECISION, ELECTRON-BEAM FURNACE FOR ACCELERATOR EXPERIMENTS. Baltrusch, E.; Bleck, J.; Rosenblum, S. S.; Zeitz, W. D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Instrum. Methods; 114: No. 2, 385-387(1974).

An electron-beam furnace for heating accelerator targets has been developed and tested. The thermal time constant of the furnace is ≈100 msec, and its temperature stability over a 6-hour experimental run is demonstrated to be better than 1°C. (auth)

16454 ELECTRON AND X-RAY BEAM CHARACTERISTICS OF THE LINAC LMR-13. Houdek, P. V.; Charyulu, K. K.; Sudarsanam, A.; Rao, A. (Univ. of Miami, FL). Radiology; 110: No. 1, 203-207(Jan 1974).

Electron beams of nominal energies 4, 8, 10, and 12 MeV were investigated. The effect of Ni and Pb scattering foils on beam penetration and field flatness is discussed and optimal combinations of beam energies and scattering foils are suggested. Depth doses are expressed as percentiles. A study of the 10 MV x-ray beam shows a need for two flattening filters for clinical ranges of field sizes. Flatness and depth dose data variations for two lead flattening filters of the same maximum thickness and central axis percentage depth doses are given. (auth)

16455 MEASUREMENT OF NEUTRON SPECTRA FROM THICK LEAD AND URANIUM TARGETS BY MEANS OF A MONOCRYSTAL SPECTROMETER. Narziev, Kh.; Matusevich, E. S.; Daruga, V. K. (Tadzhik State Univ., Stalinabad, USSR). Dokl. Akad. Nauk Tadzh. SSR; 16: No. 6, 28-31(1973). (In Russian).

The energy distribution of neutrons from thick Pb and U targets was measured in a wide energy range from 0.7 to 10 MeV. The absolute and integral yields of neutrons are tabulated and show that the high yield of neutrons from the U target is connected with a new mechanism for the production of fission neutrons. (JSR)

16456 SIMPLE 100 keV ION INJECTOR. (Shangtung Technological Univ., China). Wu-li 2: No. 2, 111-114(May 1973).

An experimental 100-keV ion injector has been designed and constructed for the production of semiconductor devices. The essential components of the injector are described, which include the ion source, analyzer, acceleration tube, sweeper, and target chamber. Experimental results of using the device to inject boron ions into silicon samples are reported. The advantages and disadvantages of the injector are briefly discussed. (JPRS)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 16644, 16732, 16879, and 16890.

16457 (BMBW-FB-W-72-25) COMPATIBILITY STUDY FOR AN ASTRONOMICAL SATELLITE A-6. Part I. Scientific Objectives and Experiments. Truemper, J.; Schoenfelder, V.; Elsaesser, H.; Lemke, D.; Grewing, M.; Wulf-Mathies, C.; Schroeder, F. K. (Zentralstelle fuer Luft- und Raumfahrtdokumentation und – Information, Munich (F. R. Germany)). Aug 1972. 125p. (In German). NTIS (U. S. Sales Only).

Three experiments for a first German Astronomical Satellite are proposed: an x-ray experiment with high-time resolution for studies of the extrasolar cosmic x-radiation and two experiments in the ir and uv region; one of them is more directed to observations of the ir brightness of the cosmic background radiation, the other more to a survey of stars by means of uv spectroscopy with high-resolution. The particular advantage consists in the long periods for single observations, which can be provided by a three-axis-stabilization. Part I of the study involves the description of the scientific objectives, the concepts and technical aspects of the experiments. In a separate Part II the feasibility of satellite concepts for a SCOUT-D launcher is discussed with respect to the mission objectives of the x-ray experiment combined alternatively with one of the other experiments. (auth)

16458 (N-73-30768) CONSISTENCY OF COSMIC-RAY SOURCE ABUNDANCES WITH EXPLOSIVE NUCLEOSYNTHESIS. Kozlovsky, B.; Ramaty, R. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Aug 1973. 14p. (NASA-TM-X-70448; X-660-73-237). NTIS $3.00.

A model was examined in which the cosmic-ray abundances of elements from C to Fe are consistent with explosive nucleosynthesis. The observed abundance of cosmic rays near the Earth, cosmic-ray source abundance, and solar system abundance are discussed along with the ratios of cosmic-ray sources to the solar system abundances. (STAR)

16459 (N-73-30796) EXPECTED GAMMA-RAY EMISSION SPECTRA FROM THE LUNAR SURFACE AS A FUNCTION OF CHEMICAL COMPOSITION. Reedy, R. C.; Arnold, J. R.; Trombka, J. I. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Feb 1973. 66p. (NASA-TM-X-70453; X-641-73-88). NTIS $5.50.

The gamma rays emitted from the Moon or any similar body carry information on the chemical composition of the surface layer. The elements most easily measured are K, U, Th, and major elements such as O, Si, Mg, and Fe. The expected fluxes of gamma-ray lines were calculated for four lunar compositions and one chondritic chemistry from a consideration of the important emission mechanisms: natural radioactivity, inelastic scatter, neutron capture, and induced radioactivity. The models used for cosmic-ray interactions were those of Reedy and Arnold and Lingenfelter. The areal resolution of the experiment was calculated to be around 70 to 140 km under the conditions of the Apollo 15 and 16 experiments. A method is described for recovering the chemical information from the observed scintillation spectra obtained in these experiments. (STAR) (auth)

16460 (N-73-31711) ISOTOPIC COMPOSITION OF HEAVY COSMIC RAYS. Maehl, R. C.; Isreal, M. H.; Klarmann, J. (Washington Univ., St. Louis, Mo. (USA). Dept. of Physics). 14p. (NASA-CR-135516). NTIS $3.00.

The mean isotopic composition was measured of even-charge cosmic-ray elements with $14 \leq 26$ near 0.8 GeV/N using a balloon-borne ionization-chamber/Cherenkov-counter detector system. The experimental method makes use of the geomagnetic field as a magnetic spectrometer. Results indicate that the most abundant isotopes at the cosmic-ray source are ^{28}Si, ^{32}S, and ^{40}Ca, like the solar system; but ^{54}Fe, unlike the solar system. (STAR) (auth)

16461 IONOSPHERIC EFFECTS OF COSMIC γ-RAY BURSTS. Brown, R. T. (Los Alamos Scientific Lab., NM). Nature (London); 246: No. 5428, 83-84(9 Nov 1973).

It has been suggested that the recently discovered bursts of γ rays of cosmic origin might produce observable ionospheric effects. Since γ rays are absorbed at a relatively low altitude compared with most other types of ionising radiation it was thought that these bursts would produce additional ionisation that might be strong enough to affect vlf radio propagation, and if data from several paths were obtained it might be possible to obtain information concerning the location of the sources. Calculations are reported that were made using a Monte Carlo code that was developed to calculate x-ray and γ-ray transport in a model atmosphere. Above 120 km the atmosphere is assumed to show negligible proton attenuation. Several simplifying assumptions were made concerning the nature of the source, and the spectrum was assumed to be independent of time. It is considered that the best chance of observing the bursts would be at low geomagnetic latitudes, where the ionisation induced by galactic cosmic rays would be of lower magnitude than that produced by the burst. The burst would produce only a very transient effect, since at the altitudes at which peak ionisation occurs the effective recombination coefficient is a very rapidly increasing function of decreasing altitude. This requires that data be recorded on a finer time scale than is usually the case, as for example when the effects of geomagnetic activity are being studied. (UK)

16462 ARE THE RECENTLY OBSERVED SOFT γ-RAY BURSTS FROM STELLAR SUPERFLARES. Stecker, F. W.; Frost, K. J. (Goddard Space Flight Center, Greenbelt, MD). Nature (London) Phys. Sci.; 245: No. 144, 70-71(1 Oct 1973).

Reference is made to the recent discovery of γ-ray bursts having a typical duration of the order of seconds and typical photon energies of the order of hundreds of keV. Predictions of γ-ray bursts from supernovae have been made, but there are several difficulties in interpreting the observed bursts as originating in supernovae. Such bursts have been observed to occur frequently, with no apparent correlation with observed supernova events. It seems that alternative possibilities for the origin of these bursts should be explored, and it is suggested that the outbursts are giant versions of the x-ray bursts seen in solar flares, to which they bear a strong resemblance in many respects to the solar x-ray bursts recently observed with a 2 sec. time resolution. The time scale is much longer than that predicted for supernovae. The spectral characteristics of the non-solar bursts have been studied in experiments carried by the satellite IMP-6. Multiple-burst events have been observed. It is stated to be plausible that the bursts are caused by the bremsstrahlung of electrons accelerated to high energies in a stellar flare event. The stellar flare hypothesis lends itself to various observational tests. Possible observational features are (1) repetitions of the bursts at the same position; (2) simultaneous radio bursts at the same position; (2) simultaneous radio bursts at the same position; and (3) γ-ray lines at 0.51 MeV (positron annihilation), 2.23 MeV ($n + p \rightarrow d + \gamma$), 4.4 MeV ($^{12}C^*$), and 6.1 MeV ($^{16}O^*$), such as have been seen in strong solar flares. These lines may be present because the flare may accelerate protons as well as electrons, so that various nuclear reactions may occur in the flare. If the stellar flare hypothesis is verified it may imply a significant source of galactic low-energy cosmic rays in the solar neighborhood, depending on the frequency and intensity of the flares. (UK)

16463 EFFECT OF IONIZATION LOSSES ON COSMIC-RAY CONCENTRATION IN THE EXPANDING UNIVERSE. Velinov, P. I. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 8, 1037-1040(1973).

The effect of ionization losses on cosmic rays in the Galaxy was examined previously [Velinov, (1969) (1970) (1971)] and the effect of losses on the spectrum, composition, and other parameters of the particles was shown. The investigations are here extended to also include metagalactic cosmic rays. (W.D.M.)

16464 UNDERGROUND MUON DATA COMPARED TO HADRONIC SCALING PREDICTIONS FROM 2 to 1000 TeV. Elbert, J. W. (Univ. of Utah, Salt Lake City); Ashley, G. K. II; Bergeson, H. E.; Keuffel, J. W.; Larson, M. O.; Lowe, G. H.; Morrison, J. L.; Mason, G. W. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 479-489(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The Utah cosmic ray detector has recorded extensive data on underground muons resulting from the early stages of hadronic cascades in the atmosphere. The measured quantities are sensitive to the hadronic interaction characteristics in the 2–1000 TeV range. The charge ratio of muons has been measured and also calculated semi-analytically by assuming scaling and using fits to accelerator data for production of mesons in hadron-nucleus collisions. In addition, a Monte Carlo program which uses the same assumptions has been developed to calculate rates of observation of multiple muons for comparison with the data. It is observed that the data are consistent with the scaling model calculations up to laboratory energies in excess of 1000 TeV. (auth)

16465 COSMIC RADIATION AND ASTROPHYSICS. Li, T. P. (Atomic Energy Inst., Peking). K'o Hsueh T'ung Pao; 18: No. 3, 97-103(Sep 1973). (In Chinese).

The phenomenon of cosmic radiation is explained and its relation to astrophysics discussed. First, Fermi's statistical theory of particle acceleration is introduced to explain the origin of cosmic rays. The development of astronomy based on the spectral distribution of radiation is discussed; specifically, three categories of astronomy, i.e., radio astronomy, optical astronomy, and cosmic-ray astronomy are summarized. The discovery of x-ray stars is also described. In addition, the impact of cosmic physics on the development of fundamental particle physics is emphasized; suggestions for future research, particularly in the high-energy regime are outlined. (JPRS)

16466 NULL CORRELATION METHOD FOR ESTIMATION OF THE PRIMARY ENERGIES OF COSMIC RAY JETS. Streitmatter, R. E. (Univ. of Maryland, College Park). Can. J. Phys.; 51: No. 8, 804-813(15 Apr 1973).

A new method for estimating the center of mass of high-energy cosmic-ray interactions is introduced and tested with a simple Monte Carlo model and a small number of cloud chamber jets. (auth)

16467 COSMIC RAY IRRADIATION PATTERNS OF LUNA 16 AND 20 SOILS: IMPLICATIONS TO LUNAR SURFACE DYNAMIC PROCESSES. Bhandari, N. (Tata Inst. of Fundamental Research, Bombay); Goswami, J.; Lal, D. Earth Planet. Sci. Lett.; 20: No. 3, 372-380(Nov 1973).

Comprehensive fossil track data in mineral grains from several horizons of Luna 16 and 20 cores are presented. The cosmic-ray irradiation of Luna 16 soil is distinctly different from Luna 20 soil, the former being more intensely irradiated. Track data for Luna 16/20 samples are compared with those for samples collected from different lunar mare and highland sites. Luna 20 track density distribution patterns are similar to those observed at other lunar sites. However, Luna 16 data are at variance and necessitate a complex irradiation history. Various suggestions made so far for explaining the high irradiation dose of Luna 16 samples appear inadequate. The possibility that the regolith growth at the Luna 16 site is governed by a different mechanism, to some extent controlled by the local topography, is discussed. (auth)

16468 RELATION BETWEEN COSMIC RAY INTENSITY VARIATIONS AND EFFECTS DUE TO THE ELECTROMAGNETIC COMPLEX. Chkhetiya, A. M. pp 75-83 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

16469 QUESTION OF THE METHOD OF STUDYING COSMIC RAY ANISOTROPY. Chkhetiya, A. M. pp 84-89 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

16470 CHARGED PARTICLE ACCELERATION IN STRONG DIPOLE FIELDS. Grewing, M. (Univ., Bonn); Heintzman, H. Mitt. Astron. Ges.; No. 32, 214-219(1973).

From Astronomical Society Scientific Meeting; Vienna, Austria (18 Sep 1972).

The interaction of charged particles with intense low frequency electromagnetic waves has been studied both analytically and numerically. New results are presented which show the resulting acceleration to be even more efficient than has previously been anticipated. Starting from reasonable initial conditions the particles can reach energies in the order of the largest cosmic ray energies so far observed. (auth)

16471 EFFECTIVE CUTOFF RIGIDITIES OF COSMIC RAYS. Dorman, L. I.; Gushchina, R. T.; Shei, M. A.; Smart, D. F. Moscow; Izdatel'stvo Nauka (1972). 152p. (In Russian and English).

Trajectory calculations for the penumbra function are used as a basis for calculating the effective cutoff rigidities of cosmic rays in a dipole field and in the actual geomagnetic field. Data are obtained for all the domestic and foreign cosmic-ray stations. Effective cutoff rigidities are tabulated as a function of the type of recording instrument, with allowance for the expected influence of cosmic-ray variations on the cutoff rigidities. (IAA)

16472 COMPARISON OF CALCULATED CHARACTERISTICS OF EXTENSIVE ATMOSPHERIC SHOWERS WITH EXPERIMENTAL RESULTS AT VARIOUS ALTITUDES. Popova, L. M. Compt. Rend. Acad. Bulg. Sci.; 26: No. 6, 743-746(1973). (In Russian).

The Monte Carlo method and analytical methods are applied to determine the parameters of some extensive atmospheric showers by using measurement data up to altitudes of 10,000 m. The energy spectrum and the spatial distribution of muons are also calculated. Good agreement is obtained between calculations and measurement results by Bennett et al. (1961) and Vernov et al. (1968). Some disagreement with other measurements is also noted. This disagreement is linked to the effects of the transverse impulse of secondary particles. (auth)

16473 SEASONAL VARIATIONS OF THE BAROMETRIC EFFECT OF THE COSMIC RAY NEUTRON COMPONENT INTENSITY. Rogava, O. G. pp 104-107 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

16474 FREQUENCY OF HEAVY IONS IN SPACE AND THEIR BIOLOGICALLY IMPORTANT CHARACTERISTICS. Curtis, S. B. (Univ. of California, Berkeley). Life Sci. Space Res.; 11: 209-214(1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

A review of the galactic cosmic-ray energy spectra of heavy ions with Z not greater than 28 is presented. Fluxes of these ions within critical body organs of astronauts travelling outside the magnetosphere will be modified from the free space values by fragmentation within the spacecraft and the bodies of the astronauts themselves. The effects of such fragmentation are presented in terms of variations in the particle flux above a given dE/dx at representative depths. Present limitations to the accuracy of such calculations are considered. The validity of dE/dx as a relevant physical parameter for characterizing the biologically important component of the heavy ion radiation environment is discussed. (auth)

16475 ORIGIN OF COSMIC RADIATION. Audouze, J.; Meneguzzi, M. Recherche (Paris); 4: 549-555(Jun 1973). (In French).

The great majority of cosmic particles come from outside the solar system. Their most striking characteristic is their enormous energy, which can reach 10^{20} eV. The chemical composition of cosmic radiation plays an important role in the study of its origin. As for the sources themselves, they must be sought among the most energetic objects, e.g., eruptive stars, novae, supernovae, pulsars, the nuclei of galaxies, or even quasars. The Sun itself emits cosmic rays of low energy. The possibility of "seeing" the sources of cosmic radiation is discussed. (IAA)

16476 MAGNETIC FIELDS AND THE DISTRIBUTION OF COSMIC RAYS IN THE GALAXY. Jokipii, J. R. (California Inst. of Tech., Pasadena). Comments Astrophys. Space Phys.; 5: No. 5, 125-131(1973).

The interstellar magnetic field and its effect on the storage and transport of cosmic rays in the Galaxy are considered. Various magnetic field models are discussed. (WDM)

Stars

Refer also to abstracts 16658, 16666, 16687, 16948, and 17534.

16477 DETECTION OF RADIO EMISSION FROM P CYGNI. Wendker, H. J. (Hamburger Sternwarte, Hamburg); Baars, J. W. M.; Altenhoff, W. J. Nature (London) Phys. Sci.; 245: No. 147, 118-119(22 Oct 1973).

It is stated that radio emission has recently been detected from several stars that show a peculiar optical spectrum, mostly with emission lines; some of these also exhibit weak so-called P Cygni-type spectral lines. The radio emission of these stars is generally considered to be of thermal origin. The authors here report the detection of radio emission from the prototype of the P Cygni stars, P Cygni itself. Some considerations are also presented on the nature of the radio emission, that may be of importance to other radio stars of this type. The Westerbork Synthesis Radio Telescope was used for observations at 5 GHz, and the 100 m telescope at the Max-Planck Institute, Effelsberg, for 10.68 GHz observations. The flux density results are shown tabulated. It is not considered that the source is variable. The positional agreement between the radio source and the star was very good. From interferometer measurements at 5 GHz it was deduced that the angular size of the radio emitting region is probably less than 1.5". The distance of P Cyg is not certain, but a "best value" of 1,200 pc is adopted in the discussion. It is concluded that the mean optical depth of the radio emitting region is close to 1 near 10 GHz and that the linear size is <0.012 pc, with a lower limit angular size of 0.22". A lower limit for the mean electron density was deduced as $\geq 1.8 \times 10^5$/cm^3 and the mass of the emission region as $\geq 2 \times 10^{-4}$ $M_\odot$. A spectral type of B1 Ia was obtained from the optical observations. The rate of mass loss is at present estimated as close to 10^{-4} $M_\odot$/yr., and it is suggested that the material which the star has lost since its outburst 300 yr. ago is actually observed in the radio range. Four additional P Cygni-type stars were also ob-

served; these were HD 108, MWC 374, AG Peg, and Z And, and no radio emission was observed from these. (UK)

16478 ARE NEUTRON STAR CORES PION CONDENSATES OR QUANTUM CRYSTALS. Palmer, R. G.; Tosatti, E.; Anderson, P. W. (Cambridge Univ., Eng.). Nature (London) Phys. Sci.; 245: No. 147, 119-120(22 Oct 1973).

It has been suggested that dense nuclear matter might achieve a lower energy by creating a large number of negative pions condensed in a small region of space. It has also been proposed that nuclear matter should undergo nuclear crystallisation at about the same density. The question of reconciliation of these two apparently conflicting possibilities is here discussed, and the suggested answer is that the two processes cooperate rather than compete; it is shown that a pion instability strongly favours the onset of crystalline ordering of the nucleons. Consideration is first given to the dependence of the pion energy–momentum relation in nuclear matter on the density. It is concluded that crystal ordering and pion condensation are symbiotic rather than antagonistic in dense neutron star matter. The anisotropic nature of pion condensation favours layer structure rather than cubic crystals, and the presence of an anisotropic crystalline core in at least the heavier neutron stars should be seriously considered. The change in nucleon ordering at pion condensation and the intrinsic softness of a layer structure are relevant to the the theory of corequakes. (UK)

16479 PROTOSTELLAR ORIGIN OF CIRCUMSTELLAR ENVELOPES. Baglin, A. (Observatoire de Nice, France); Berruyer, N.; Morel, P. J.; Pecker, J. C. Astrophys. Lett.; 15: No. 1, 9-15(Sep 1973).

Numerical protostellar models indicate that the envelope contraction time scale is greater than that of the core. For massive objects the envelope still exists when the main sequence is reached; in the envelope and H II region develops and the dust grains are still present. In this framework, some observational facts are discussed and observational tests are proposed. (auth)

16480 TRANSFER EQUATIONS FOR NORMAL WAVES AND RADIATION POLARIZATION IN AN ANISOTROPIC MEDIUM. Gnedin, Yu. N.; Pavlov, G. G. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1806-1817(Nov 1973). (In Russian).

The conditions of applicability of the transfer equations for normal waves are found (orthogonality of normal waves or a large phase shift between the waves over a mean free path). Expressions are derived for the degree of orthogonality of normal waves in an axially symmetric medium (magneto-active plasma or gas of atoms experiencing the normal Zeeman effect). Simple formulas for the degree of circular polarization of radiation emitted by the atmosphere of a star with a strong, dipole-like magnetic field are derived on basis of the equations for the normal wave intensities. The polarization of radiation at large depths of an anisotropic medium is considered and it is pointed out when such polarization may occur. (auth)

16481 SOME PROBLEMS ON THE RADIATIVE RELAXATION OF IONIZED HYDROGEN OPTICALLY THICK AT LINES FREQUENCIES. Gershberg, R. E. Izv. Krym. Astrofiz. Observ.; 46: 59-82(1972). (In Russian).

In order to improve the methods of photometric analysis of the UV Cet-type star flares some problems of the radiative relaxing hydrogen plasma optically thick at Balmer line frequencies are considered. Diffuse Balmer continuum radiation is shown to be small in flares and therefore the effective recombination coefficient is determined by the value $\Sigma_{k=2}^{\infty} C_k$. The power of plasma radiation in the ultraviolet region $S_u \propto T_e^{-0.3}$ and the dependence of S_u on the optical thickness is shown to be small. General formulae for plasma radiative losses are obtained accounting for finite populations of hydrogen excited levels. The role of nonstationary L_α radiation field is considered in detail. (WDM)

16482 INFLUENCE OF RADIATION LOSSES ON THE SPECTRUM OF TURBULENCE IN STELLAR ATMOSPHERE. Golland-skii, O. P. Izv. Krym. Astrofiz. Observ.; 46: 83-89(1972). (In Russian).

A solution of the spectral equation of isotropic turbulence with the nonlinear term in Kovasznay's form modified by Panchev and with a term accounting for the energy dissipation by radiation was analyzed. It is shown that under the influence of radiation losses the spectrum becomes steeper (compared to the case when this influence is absent) in the interval of wave numbers corresponding to the turbulent eddy scale comparable with the photon free path. (auth)

16483 ABUNDANCE OF LITHIUM IN THE ATMOSPHERES OF TWO dM5 STARS. Boyarchuk, M. E. Izv. Krym. Astrofiz. Observ.; 46: 54-58(1972). (In Russian).

Nine spectrograms of the flare star AD Leo M4,5 V and of Barnard star BD + 4° 3561 M5 VI (disp. 12 and 24 Å/mm) were investigated by the curves of growth method. The line LiI λ 6707.9 was identified. The equivalent widths of 10 absorption lines Ca I and of 20 absorption lines Fe I were measured. The physical parameters of stellar atmosphere obtained are the following, parameter of Doppler velocity v_{DLi}, excitation temperature $\Theta_B = 5040/T_B$, and relative abundance of Li, $\lg N_{Li}/N_{Ca}$. It is shown, that $\lg N_{Li}/N_{Ca}$ in the atmosphere of star BD + 4° 3561 is 14 times smaller, and in the atmosphere AD Leo it is 160 times smaller in comparison with the solar abundance. (auth)

16484 SPECTROPHOTOMETRIC STUDY OF ECLIPSING-VARIABLE SYSTEMS. II. Rachkovskaya, T. M. Izv. Krym. Astrofiz. Observ.; 46: 35-46(1972). (In Russian).

The spectra of eclipsing-variable systems EM Cep, Z Vul, IM Mon, λ Tau, RS Vul, V822 Aql, U Sge, and RX Her were obtained with a dispersion of 15 and 36 Å/mm near the phases 0.00 p; 0.25 p; 0.50 p; and 0.75 p. Using the spectrograms obtained spectral types, absolute visual magnitudes, rotational and synchronous velocities were determined. The results of the study show, that: (1) components of the systems studied lie on the main sequence of the H–R diagram; (2) possibly nearly all stars examined have the axial-orbital synchronism. (auth)

16485 FIVE-COLOR TV-PHOTOMETRY OF DI CEP. Petrov, P. P. Izv. Krym. Astrofiz. Observ.; 46: 25-34(1972). (In Russian).

A special 4-color photometric system within spectral range 0.37 to 0.73 mkm was used for TV-photometry of DI Cep. This system is free from the influence of bright lines in the spectra of T Tau stars. A fifth pass-band was used for estimation of H_β emission. Observations showed irregular variations of color temperature between 9500 and 5000°K. At the maximum of the temperature of DI Cep its energy distribution in the continuum was similar to that of normal A stars with Balmer-jump in absorption. Decrease of the temperature was followed by the diminuation of Balmer-jump down to zero and brightening of H_β emission line. The position of DI Cep on the log R vs log T theoretical diagram permitted estimation of its mass within 1.2 to 1.7 $M_\odot$. (auth)

16486 ATMOSPHERE OF THE HYDROGEN-DEFICIENT STAR HD 135485. Schoenberner, D. (Technische Univ., Berlin). Astron. Astrophys.; 28: No. 3, 433-440(Nov 1973).

A fine analysis of the so-called hydrogen-deficient star HD 135485 was performed by using a grid of flux constant model atmospheres. Opacities considered were H I, including the Lyman- and Balmer-lines, H^-, He I, He II, He^-, and electron scattering. The following quantities were computed with these models: the profiles of H_γ and H_δ, the profiles of 5 He I-lines, the ionization equilibria of Al II/Al III, Si II/Si III, S II/S III, and Fe II/Fe III for various turbulent velocities. The model which represents best the observations had $T_{eff} = 18400$°K and $\log g = 4.40$. The helium content turned out to be almost normal ($n_{He} = 0.16$ by number fraction). The metal abundances appeared unusually high. The turbulent velocity was 10 km/s. Mass, radius, and luminosity were estimated to be $M/M_\odot = 9$, $R/R_\odot / 3.1$ and $L/L_\odot / 0.7 \cdot 10^3$, which closely resembled the data of a main-sequence star. (auth)

16487 SEARCH FOR DEPARTURES FROM LTE IN THE SPECTRA OF G AND K TYPE GIANTS AND SUPERGIANTS. van Paradijs, J. (Univ., Amsterdam). Astron. Astrophys.; 28: No. 3, 385-392(Nov 1973).

Results of an empirical study of observable effects of deviations from LTE in the spectra of G and K type giants and supergiants are presented. For giants the effective temperature, as derived from the color index R-I, and from a curve of growth analysis of the line spectrum of FeI, agree closely. The comparison of the effective temperatures from FeI and TiI does not, as yet, provide a trustworthy test of LTE. The FeI spectrum was searched in detail for deviations of the relative line strengths from the LTE predictions. No clear evidence (at least with respect to the uncertainty introduced by the errors in the measured line strengths) could be found for a serious breakdown of the LTE assumption in the analysis of these stars. (auth)

16488 NEBULAR STAGE OF NOVA DELPHINI 1967. II. Malakpur, I. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 28: No. 3, 393-402(Nov 1973). (In French).

The Balmer decrement was used to determine the processes of formation of the permitted emission lines in the envelope of Nova Delphini. A considerable disagreement was found between the observed Balmer decrement and that calculated for the case of radiative ionization. The influence of self-absorption and collisional excitation and ionization by free electrons on the observed Balmer decrement was studied. The effects of self-absorption and collisions cannot explain the observed Balmer decrement. The influence of interstellar absorption is discussed and the Balmer

decrement is explained by reddening. It was found that the constant of reddening shows an abrupt variation with time. Owing to the fact that such a variation could not be produced by interstellar matter, it was concluded that this supplementary reddening is due to a dusty circumstellar envelope of the Nova. The results obtained from the study of extinction and polarization lead one to conclude that the grains of the circumstellar envelope are of graphite with or without an ice mantle, having a radius of order of 0.10 micron. It is believed that this circumstellar envelope is a result of the preceding explosion. (auth)

16489 REMARKS CONCERNING THE S-PROCESS. Zeh, H. D. (Univ. of California, San Diego). Astron. Astrophys.; 28: No. 3, 427-428(Nov 1973).

The abundances of ^{58}Fe and ^{59}Co are far too large to be compatible with an s-process acting on ^{56}Fe as the only essential seed material unless a sharp lower cut-off is introduced ad hoc into the flux distribution. This cut-off leads to a maximum in the abundance times cross-section curve around A = 60 for which there is evidence but which can naturally be explained as an image of the iron peak shifted by an almost uniform neutron flux. Further evidence supports the conclusion of Peters et al. that the iron peak must have been considerably smaller for the seed of the s-process than for the solar system matter. (auth)

16490 SECULAR STABILITY. VI. An Instability Associated with the Perturbation of Chemical Abundances. Aizeman, M. L. (Univ. of Montreal); Perdang, J. Astron. Astrophys.; 28: No. 3, 327-333(Nov 1973).

Unstable, discrete modes are found to exist in the secular spectrum of stars when perturbations of chemical abundances are considered. The time scales of the instabilities correspond to the evolution time scales. Such instabilities have been found in all of the models tested. (auth)

16491 FINE ANALYSIS OF THE A 0 Ia–O SUPERGIANT HD 7583 IN THE SMALL MAGELLANIC CLOUD. Wolf, B. (European Southern Observatory, Santiago de Chile). Astron. Astrophys.; 28: No. 3, 335-348(Nov 1973).

A model atmosphere analysis of HD 7583, an extreme A 0 Ia–O supergiant in the wing of the Small Magellanic Cloud was done by evaluating 7 high dispersion spectra in the range $3500 < \lambda < 6600$ Å (12.3 and 31.3 Å/mm) taken at ESO, La Silla. The observations were best fitted by a model atmosphere (radiative equilibrium, LTE, no line blanketing) with the parameters $T_e = 8960°$ and $\log g = 0.87$ and a depth dependent microturbulence. The resulting metal abundance distribution was the same as for galactic A-supergiants and HD 33579 in the LMC within the accuracy of the analysis. A tentative chromospheric model was worked out for the interpretation of the He-absorption lines and the strong and redshifted variable H_α-emission. The bolometric correction was B.C. = 0.19. The luminosity was $L/L_\odot \approx 500{,}000$, the radius was $R/R_\odot \approx 295$, and the mass was $M/M_\odot \approx 24$. HD 7583 is in the He-burning evolution stage with an evolution time $t_E \approx 5.4 \cdot 10^5$ (years) and fits in an independent age determination of the wing of the SMC. The results of the abundance determination are discussed in connection with the theoretical framework of the chemical evolution of the galaxies and the general validity of Cepheids as distance indicators. (auth)

16492 GENERATION OF MAGNETIC FIELD IN BINARY CELESTIAL SYSTEMS. Dolginov, A. Z. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 38-39(5 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 67-70(5 Jul 1973).

Generation of a field in a star surrounded by a disk-like cloud that revolves around the star with its axis inclined to the stellar rotation axis is considered. (W.D.M.)

16493 ULTRAVIOLET SPECTRA OF GAMMA VELORUM AND ZETA PUPPIS. Burton, W. M.; Evans, R. G.; Griffin, W. G.; Lewis, C.; Paxton, H. J. B.; Shenton, D. B.; Macchetto, F.; Boksenberg, A.; Wilson, R. (Culham Lab., Abingdon, Eng.). Nature (London) Phys. Sci.; 246: No. 151, 37-40(19 Nov 1973).

High quality uv spectra of gamma Velorum and zeta Puppis were recorded during a Skylark rocket flight from Woomera, S. Australia, on June 16th, 1973. The instrumentation consisted of a package of three objective grating spectrographs with a combined wavelength range of 900 to 2300 Å. The spectral resolution was adequate to observe interstellar absorption lines and to study line profiles produced in the stellar atmospheres and the expanding circumstellar regions. zeta Pup is of spectral type 05f and is the brightest star of this classification. Both stars show strong P Cygni line profiles, indicating that mass-loss processes are occurring. The observations extend the wavelength range recorded with high spectral resolution, and will permit a more detailed study of the interstellar gas in the direction of the Gum Nebula; they also provide new information about the atmospheres of the two stars. In this preliminary report the analysis is limited to a description of the interstellar line spectrum and some deduced column densities. The interpretation of P Cygni line profiles is also briefly discussed. The interstellar lines of the more abundant elements are discussed, including C, N, O, F, Al, Si, P, and S. The two stars seem to be associated with the Gum Nebula and may be partly responsible for the ionization in this extended region. Estimates of distances are uncertain, but it seems probable that both stars are at about the same distance as the Vela X supernova remnant (~460 pc). The column density was derived by fitting theoretical absorption line profiles to the observed data, and the interstellar atomic H density estimated from models of the interstellar medium. (UK)

16494 SMOOTHING OF A TEMPERATURE FLUCTUATION BY MEANS OF RADIATION AND CONDUCTION. Anderson, D. (Chalmers Univ. of Tech., Goteborg). Astron. Astrophys.; 29: No. 1, 23-27(Nov 1973).

The damping of a temperature fluctuation by means of conduction and radiation is investigated. The medium is assumed to be homogeneous, grey, and in a non-LTE state characterized by its albedo for single scattering. A relation between the decay time and the characteristic spatial variation of harmonic fluctuations is obtained and studied for several limiting cases. The relative importance of conduction and radiation is investigated as well as the influence of scattering upon the efficiency of the radiation as an agent of energy transport. (auth)

16495 MICROTURBULENCE IN STELLAR SPECTROSCOPY: THE TURBULENT ELEMENT APPROACH. Hundt, E. (Univ., Heidelberg). Astron. Astrophys.; 29: No. 1, 17-21(Nov 1973).

The concept of microturbulence in spectral line formation is generalized by introducing turbulent eddies with a finite size. Line calculations with this simple velocity pattern yield apparent microturbulent velocities which are appreciably smaller than the actual velocities, and which depend on the physical line parameters. (auth)

16496 SEARCH FOR VARIABILITY OF FREE–FREE EMISSION FROM CIRCUMSTELLAR GAS SURROUNDING Be STARS. Merrill, K. M. (Univ. of California, San Diego); Stein, W. A. Astron. Astrophys.; 29: No. 1, 163-164(Nov 1973).

Four Be stars (ϕ Per, 48 Per, χ Oph, π Aqr) were observed at wavelengths of 3.5 μ and 11 μ for approximately three years. Earlier observations had indicated that perhaps the flux of free–free emission giving rise to a portion of the observed radiation was variable. No definite variability was observed. Limits on the degree of variability allowed by the observations were determined. (auth)

16497 SPECTRAL GRADIENT AROUND WAVE-NUMBER 2.34. Ardeberg, A. (Inst. fuer Astronomi, Lund, Sweden). Astron. Astrophys.; 29: No. 1, 151-154(Nov 1973).

A comparison is made between the new data on spectral gradients in "the blue spectral region" given by Chalonge and Divan (1973) and the calibration given by Ardeberg (1969). For stars of low luminosity excellent agreement is found. Only for spectral types earlier than B3 a discrepancy is present. If the data of Chalonge and Divan are corrected for the influence of wavelength-dependent interstellar absorption the differences disappear completely. Also the results for supergiant stars given by Chalonge and Divan are in very good agreement with the calibration by Ardeberg. (auth)

16498 ABSOLUTE ENERGY DISTRIBUTION OF TWO DELTA SCUTI VARIABLES. Joshi, S. C.; Rautela, B. S. (Uttar Pradesh State Observatory, Naini Tal, India). Astron. Astrophys.; 29: No. 1, 155-157(Nov 1973).

The absolute energy distributions of two δ Sct stars β Cas (HR 21) and ν UMa (HR 3888) are given. By matching these with model atmospheres their effective temperatures, gravities, radii, and masses are estimated. (auth)

16499 STUDY OF TWO TYPE II SUPERNOVAE: SN 1961 IN NGC 3938 AND SN 1969 IN NGC 1058. Gordon, C. (IBM Watson Research Center, Yorktown Heights, NY). Astron. Astrophys.; 29: No. 1, 123-127(Nov 1973).

A density model of Type II supernovae shells consistent with the position of the maximum of absorption in the Balmer and Paschen lines of hydrogen is proposed. The mass of the shell is evaluated assuming different values for the time of the maximum luminosity. (auth)

16500 DETECTION OF BINARIES WITH A COLLAPSED COMPONENT. Sutantyo, W. (Univ., Amsterdam). Astron. Astrophys.; 29: No. 1, 103-107(Nov 1973).

Conditions are developed for the observable system parameters of evolved close binaries in which one of the components

has collapsed through a supernova explosion. It is adopted that the total mass of the system is conserved during the mass transfer preceding the explosion. These conditions set an upper limit to the mass of the possibly collapsed component in an observed single line spectroscopic binary or in an x-ray binary. Only one binary in the lists of noneclipsing single line spectroscopic binaries given by Trimble and Thorne (1969) fulfils these conditions. The fact that most x-ray binaries also fulfil these conditions leads to the conclusion that in most cases the amount of mass loss during the first stage of mass transfer has not been very large. From the very small mass functions of most massive x-ray binaries it seems that massive binaries with very small mass functions could be more likely candidates for having a collapsed component than massive binaries with large mass functions. (auth)

16501 SPECTRAL LINE FORMATION IN A TURBULENT ATMOSPHERE: A UNIFIED THEORY. Auvergne, M.; Frisch, H.; Frisch, U.; Froeschle, C.; Pouquet, A. (Observatoire de Nice). Astron. Astrophys.; 29: No. 1, 93-102(Nov 1973).

In order to bridge the gap between the usual microturbulent and macroturbulent approximations, the formation of spectral lines in a turbulent medium in which the eddies have a finite scale were studied. The variation of the velocity along the line of sight was represented by a Kubo–Anderson process for which the probability distribution and the correlation length, or its inverse the eddy density n, can be adjusted arbitrarily. Exact analytical expressions were obtained for the mean line profile, its statistical dispersion, and also for the mean curve of growth. The macro- and microturbulent approximations were recovered respectively for $n = 0$ and $n = \infty$. It was found that in the far wings the mean profile becomes independent of the eddy density. It is shown that the position of the plateau of the curve of growth depends both on the eddy density and on the r.m.s. turbulent velocity ζ; a unique determination of the latter is therefore not possible. (auth)

16502 SPECTRUM, ORBIT, AND MAGNETIC FIELD OF HD 153919 (2U 1700-37). Hensberge, G.; van den Heuvel, E. P. J.; Paes de Barros, M. H. (Astronomical Inst., Utrecht). Astron. Astrophys.; 29: No. 1, 69-75(Nov 1973).

A radial velocity study of the O 6.5f star HD 153919 (optical candidate of 2U 1700-37) shows this star to be a 3.412d spectroscopic binary with a mass function of $0.0036\ M_\odot \pm 20\%$. A recurrent disturbance of the radial velocity curve around phase 0.30 is noticed. From 10 Zeeman spectra no magnetic field of strength larger than the probable error (3500 Gauss) is found. The shallow emission features of 100 to 180 Å wide around H_δ and H_γ as reported by Walker are confirmed. A similar feature of over 120 Å wide is found around C III λ 4650 (and probably also around He II λ 4686) and indicates an outflow velocity of the order of 4000 km/s. Problems with the determinations of masses of early-type supergiants in x-ray binaries are discussed and a lower mass limit of between 0.7 $M_\odot$ and 1.5 $M_\odot$ is obtained for 2U 1700-37. (auth)

16503 ABUNDANCE OF THE LITHIUM IN THE ATMOSPHERES VARIABLE M-STARS OF TYPE SR. Boyarchuk, M. E. Izv. Krym. Astrofiz. Observ.; 46: 47-53(1972). (In Russian).

Twenty spectrograms of seven variable M-stars with dispersion 12 Å/mm were obtained with the coude spectrograph of the 2.6 m telescope of the Crimean observatory in 1968–1969. A spectroscopic survey was made by the curves of growth method. The line Li I λ 6707.9 was identified. The equivalent widths of 10 absorption lines Ca I and of 20 absorption lines Fe I are measured. The parameters $\nu_{D\,I}$, T_B and $\lg(N_{Li}/N_{Ca})$ for stellar atmosphere were determined. The abundance ratio $\lg(N_{Li}/N_{Ca})$ for atmospheres of SR type stars M5 III – M8 III is near to the abundance ratio $\lg(N_{Li}/N_{Ca})$ in the atmospheres of normal MO III – M3 III stars and about 10 times smaller compared with the solar atmosphere. (auth)

16504 NON-LTE-EFFECTS AND INFLUENCE OF HELIUM ABUNDANCE IN AO IA-SUPERGIANT-ATMOSPHERES. Kudritzki, R. P. (Technische Univ., Berlin). Astron. Astrophys.; 28: No. 1, 103-107(Oct 1973).

Non-LTE (and also LTE) model atmospheres are constructed, using the method of complete linearization of Auer and Mihalas, for $T_{eff} = 10{,}000°K$ and $\log g = 1$. Various number ratios (N(He)/N(H)) are assumed. Two effects are found: 1. The continuum radiation field depends strongly on the helium abundance. 2. The structure of the entire atmosphere is subject to non-LTE-effects, even in the region of continuum formation. In consequence, large changes in the continuum radiation field occur due to non-LTE. (auth)

16505 DEPENDENCE OF THE FLARE ACTIVITY OF UV CET-TYPE STARS ON THEIR AGE. I. Chugainov, P. F. Izv. Krym. Astrofiz. Observ.; 46: 14-24(1972). (In Russian).

Characteristics of the flare activity of 14 red dwarf stars were determined. Twelve of them were UV Cet-type stars. The most detailed material was considered for 4 stars (AD Leo, EV Lac, YZ CMi, and UV Cet), for which observations were made during the International Patrol of Flare Stars. It was found for these stars that the number of flares and the mean energy emitted (per the unit of time) did not vary for 2 to 3 years, and the differences observed were due to the effect of observational selection. The distribution of 14 stars studied on the diagram "absolute magnitude M (102) —color index (102, 65)" showed that there are young and old stars between them. Young UV Cet-type stars possess the higher flare activity. (auth)

16506 IRON ABUNDANCE OF 82 ERIDANI. Hearnshaw, J. B. (Australian National Univ., Canberra). Astron. Astrophys.; 29: No. 2, 165-170(Dec 1973).

An iron abundance of $[Fe/H] = -0.34$ was obtained from a differential model atmosphere analysis of the Fe I spectrum of the southern high velocity G 5 dwarf 82 Eridani (HR 1008). The calculations of the Fe I spectrum for a grid of line-blanketed model atmospheres in the range $0.80 \leq \theta_{eff} \leq 1.00$ and $\log g = 4.5$, 4.0, 3.0 are presented so as to enable other stars to be analyzed by the same method. (auth)

16507 RECENT OBSERVATIONS OF THE SPECTRUM OF THE OF-STAR HD 108. Andrillat, Y. (Laboratoire d'Astronomie de Montpellier, France); Fehrenbach, C.; Swings, P.; Vreux, J. M. Astron. Astrophys.; 29: No. 2, 171-177(Dec 1973). (In French).

Spectrograms of HD 108 covering a wide spectral range (3200 to 8000 Å) were obtained in 1971 and 1972 at the Haute Provence Observatory. They are described in detail and compared to previously published observations. New emission lines were detected (3806, 4415, 4417, 6340 Å) as well as new rapid intensity variations (He I: 4026.2 Å, 4387.9 Å; N III: $3s^4P^0-3p^4D$ and $4^2P^0-5^2G$; Si IV: $4s^2S-4p^2P^0$). The measured radial velocities are compatible with an expanding atmosphere which exhibit a marked acceleration toward the outer layers. (auth)

16508 ACCRETION ONTO MASSIVE BLACK HOLES. Pringle, J. E.; Rees, M. J.; Pacholczyk, A. G. (Univ. of Sussex, Brighton, Eng.). Astron. Astrophys.; 29: No. 2, 179-184(Dec 1973).

The observable effects of accretion onto massive ($\gtrsim 10^4\ M_\odot$) black holes are considered, particularly in the case when angular momentum is important. Such objects could be extremely luminous, even if the surrounding density were very low. (auth)

16509 EVOLUTIONARY MODELS OF A 20 $M_\odot$ STAR WITH DIFFERENT INITIAL CHEMICAL COMPOSITION. Barbaro, G.; Bertelli, G.; Chiosi, C.; Nasi, E. (Univ., Padua). Astron. Astrophys.; 29: No. 2, 185-198(Dec 1973).

The evolution from the main sequence up to the central He depletion of a 20 $M_\odot$ star with six different sets of initial composition parameters was followed. Semiconvective regions were computed according to the Schwarzschild–Härm criterion. The analysis of the results indicated that during central He-burning two phases can be displayed: a first one, at the beginning of the burning, ($Y_c \gtrsim 0.500$) in which the evolutionary effects are essentially due to the advancement of the H-burning shell, and a late one ($Y_c < 0.200$) whose behavior can be accounted for only by the chemical evolution of the core, with the exception of a phase of secular instability. Theoretical distribution of stars in the different parts of the H.R. diagram were derived in the cases of both the Schwarzschild–Härm and the Ledoux criterion, and compared with observed distributions of galactic supergiant stars. The comparison seemed to indicate that a better agreement is obtained when the neutrality condition adopted for semicovective region is the Schwarzschild–Härm condition. (auth)

16510 CHROMOSPHERES OF T TAURI-TYPE STARS. Dumont, S.; Heidmann, N.; Kuhi, L. V.; Thomas, R. N. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 29: No. 2, 199-205 (Dec 1973).

The observed total fluxes of H α emission for some 20 T Tauri stars in the Taurus–Auriga cloud are used to test the hypothesis that the observed emission features can be produced by a chromosphere without recourse to an extended envelope. Under the assumption that the Balmer continuum emission is produced in the chromosphere and that H α is photoionization dominated, total emission fluxes are obtained that are in good agreement with the observed values. However the predicted profiles have a necessary central reversal which is not always present in the observed ones. It is suggested that the agreement can be improved by the introduction of a velocity gradient as required by the present ideas on the existence of chromospheres. (auth)

16511 ABSOLUTE ULTRAVIOLET SPECTROPHOTOMETRY FROM THE TD 1 SATELLITE. I. Absorption Features in the uv Spectra of B Stars. Swings, J. P.; Jamar, C.; Vreux, J. M. (Univ., Liege). Astron. Astrophys.; 29: No. 2, 207-210(Dec 1973).

A dozen strong absorption features are detected in the S 2/S 68

spectra of B type stars between 1350 and 2550 Å. Tentative identifications are given for most of them as well as a discussion of their behavior from star to star. In particular a broad blend around 1540 Å is mainly due to C IV in early B stars whereas it is mostly due to Si II in late B stars. A broad absorption around 1940 Å appearing in a few stars is described. (auth)

16512 ABSOLUTE ULTRAVIOLET SPECTROPHOTOMETRY FROM THE TD 1 SATELLITE. II. Observations of B Star Continua Shortward of 2500 A. Vreux, J. M.; Malaise, D.; Swings, J. P. (Univ., Liege). Astron. Astrophys.; 29: No. 2, 211-216 (Dec 1973).

The slope of the continuous energy distribution determined from 1800 to 2500 Å on calibrated S 2/S 68 spectrophotometric tracings is well correlated with the spectral type and the B−V color index of 80 bright B stars. A flux ratio defined with respect to such a slope is then considered to be a measurable characteristic of each spectral type along the sequence B 0 to B 9.5. The absolute level of the Balmer continuum is described in terms of an index representing the uv excess (or deficiency) of the stellar continuous flux at 2100 Å with respect to a model for Vega. (auth)

16513 INTERACTION OF HOT STARS AND OF THE INTERSTELLAR MEDIUM. III. Excitation Sources for Small Galactic Nebulae. Chopinet, M.; Georgelin, Y. M.; Lortet-Zuckermann, M. C. (Observatoire de Bordeaux). Astron. Astrophys.; 29: No. 2, 225-230(Dec 1973).

Evidence is presented for the presence of hot stars associated with a number of small galactic nebulae and probably responsible for their excitation. Thus, excitation mechanisms other than ultraviolet stellar radiation, as suggested by Terzian (1970) and Turner (1971) are not necessary. (auth)

16514 SCHEME OF STELLAR ATMOSPHERIC REGIONS. I. The General Approach. Pecker, J. C.; Praderie, F.; Thomas, R. N. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 29: No. 2, 289-296(Dec 1973).

The idea of the stellar atmosphere as a transition zone between the quasi-equilibrium stellar interior and the wholly nonequilibrium interstellar medium is developed. The transition is between a primarily-storage, and a primarily-propagation, configuration for the energy associated with each of the radiation and mass-fluxes. Each phase of the transition, for the radiative flux, gives rise to one region of the photosphere; for the mass-flux, to one region of the hylosphere. A schematic outline of the phases is provided. (auth)

16515 SCHEME OF STELLAR ATMOSPHERIC REGIONS. II. Properties and Significance of Mass Flux. Thomas, R. N. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 29: No. 2, 297-307(Dec 1973).

It is shown that observed mass-fluxes from stars require photospheric systematic velocities in excess of those which would exist if mass-fluxes came only from radiative effects. Thus it is inferred that chromospheres and mass-fluxes of the observed sizes are always associated, and depend upon a storage in the star of nonthermal kinetic energy. A complete picture of atmospheric structure thus requires adding mass-flux to radiative flux and gravity as the parameters necessary to compute atmospheric models. Either a fourth parameter, or specification of the storage mode for nonthermal energy is necessary to specify the kind of lateral inhomogeneities which occur. It is shown that such a model predicts the kind of line-broadening, and the luminosity dependence, represented by the Wilson−Bappu and similar effects, and to first-order it has nothing to do with turbulence. A sequence of nonradial pulsations might represent one kind of sequence of nonthermal kinetic energy storage. (auth)

16516 NEUTRON STAR MATTER. Phase Transition to a Neutron Solid. Oestgaard, E. Ark. Fys. Seminar Trondheim; No. 17, 1-9(1973).

The ground-state energy and pressure of a neutron solid are calculated by means of a modified Brueckner theory. The possibility of a phase transition from normal neutron matter into a neutron solid is then considered, but no phase transition is found to occur for the specific two-body potential assumed. (auth)

16517 BLUE OBJECTS IN THE REGION AROUND THE M92 GLOBULAR CLUSTER. Mnatsakanyan, R. G.; Saakyan, K. A. Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR; No. 44, 43-80(1972). (In Russian).

A total of 843 blue objects were detected by observations from Sept. 4, 1966, through July 23, 1968, on a 40-in. telescope in an area of 16 sq deg around the M92 cluster. A table of color characteristics and photographs of the objects are included. A blink-comparator was used for the identification of blue objects. (IAA)

16518 MEAN ABSOLUTE MAGNITUDE OF THE RR LYRAE STARS. Heck, A. (Institut d'Astrophysique de Liege). Astron. Astrophys.; 24: No. 2, 313-316(Apr 1973). (In French).

The mean absolute magnitude and the dispersion in magnitude were determined for a sample of RR Lyrae stars from Hemenway's (1971) paper, which is more important (125%) and better (new proper motions, corrections of identification of stars) than the sample used by Heck (1972). In "mean light" magnitude, the results are: $\overline{M}_v = 0.51 \pm 0.20$ and $\sigma^2_{M_v} = 0.56 \pm 0.22$ and are coherent with those of Heck (1972) and Hemenway (1971). The cosecant absorption law is found a little too strong. The results about the relations between $\overline{M}_v$, $\sigma^2_{M_v}$, the period P, the abundance parameter ΔS, the light variation amplitude A, studied in Heck (1972) are all confirmed but one: $\overline{M}_v - A$. The presence of stars with δ Scuti properties in the RR Lyrae stars with period shorter than 0.4 day was confirmed. (auth)

16519 OBSERVATION OF THE γ CASSIOPEIAN STAR (Be SPECTRAL TYPE) USING FOURIER SPECTROMETRY BETWEEN 1 AND 2.5 μ. Maillard, J. P. (CNRS, Orsay, France). Compt. Rend., Ser. A, B; 277: No. 5, 127-130(30 Jul 1973). (In French).

The spectrum of the Be type star γ Cassiopeia was studied between 1 and 2.5 μ using Fourier spectrometry. The hydrogen lines of the Paschen, Brackett, and Pfund series and helium I lines were observed. (FR)

16520 CONTRIBUTION OF THE THREE-DIMENSIONAL ANALYSIS OF THE VELOCITY FIELD OF YOUNG STARS. Moser, F.; Mennessier, M. O.; Creze, M. (Observatoire de Paris). Astron. Astrophys.; 29: No. 3, 441(Dec 1973).

The three-dimensional analysis shows that the presence of motion along the z-axis does not change a previous interpretation of the velocity field of young stars. (auth)

16521 SEARCH FOR STELLAR MICROTURBULENCE. Gray, D. F.; Evans, J. C. (Univ. of Western Ontario, London). J. Roy. Astron. Soc. Can.; 67: No. 5, 241-247(Oct 1973).

Evidence for the existence of microturbulence in main-sequence stars is reviewed. Alternative explanations for the curve-of-growth evidence are given and the expected behavior of absorption line profiles due to microturbulence is presented. Steps for detecting the microturbulence effects in profiles are outlined. (auth)

16522 CLUSTER NGC 6256. Terzan, A.; Lelievre, G. (Observatoire de Lyon, Paris). Astron. Astrophys.; 29: No. 3, 431-433(Dec 1973).

The cluster NGC 6256 only listed up to now in the NGC was observed in the blue and infrared with an image tube mounted at the Cassegrain focus of the 1.52m ESO telescope. The nature of the cluster (galactic, globular, or intermediate) is discussed. (auth)

16523 FREQUENCY OF TYPE I AND TYPE II SUPERNOVAE. Dallaporta, N. (Univ., Padua). Astron. Astrophys.; 29: No. 3, 393-399(Dec 1973).

Using the recent statistical data collected by Tammann on supernovae, an attempt was made to deduce the frequencies of those events which are relevant for stellar evolution. The main points inspiring the investigation were the separation of Type I supernovae into two subtypes occurring respectively in young (SN Iy) and in old (SN Io) stellar populations, and the determination of the frequencies of SN II, SN Iy, and SN Io events per unit galactic mass and per stellar population type. The frequencies thus obtained were used to determine, according to the Salpeter birthrate function, the stellar mass range to which these different types of events may be referred. For the case of the young population it turned out that the frequencies of both SN II and SN Iy events indicated a value of $\sim 10\ M_\odot$ as the lower limit to the initial main-sequence mass range of the presupernovae. (auth)

16524 STABILITY OF A SELF GRAVITATING SYSTEM WITH PHASE SPACE DENSITY FUNCTION OF ENERGY AND ANGULAR MOMENTUM. Doremus, J. P. (Groupe de Physique Theorique et Plasma, Nancy); Feix, M. R. Astron. Astrophys.; 29: No. 3, 401-407(Dec 1973).

A self-gravitating stellar system was considered with spherical symmetry and a phase space density function of the two invariants: energy and angular momentum. The special case of a "Water-Bag" model was considered and it is shown that this model is stable for radical perturbation. For this proof layers of constant angular momentum were considered. This decomposition provides an infinite set of equations for the fields and the eigenvalues can be shown to be positive. A function F of the two integrals of motion ϵ, I, was approximated by a succession of steps corresponding to a multiple "Water-Bag". The method developed is extended to this case. It was deduced that a model with $\partial F/\partial \epsilon < 0$ is stable for radial perturbations. (auth)

16525 SPECTRAL LINE FORMATION IN NON-LTE EXPANDING ATMOSPHERES. Simonneau, E. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 29: No. 3, 357-367(Dec 1973).

The local transfer equation is formulated for an optically thick atmosphere in which a linear velocity field is present, in order to obtain an integral equation for the line source function. The study and solution of this equation compared with that for the "static case" makes clear the effect of the shift of the absorption coefficient, due to the velocity gradient, upon the photons emitted in the line, in the continuum, and coming from the exterior (incident intensity). In some cases, the line source function in presence of a velocity gradient can be greater than in the "static case". The variation of emergent intensity with direction is greater than in the "static case"; consequently the geometric effect produced on the flux by this variation is very important. Emergent intensities and fluxes have also been computed. Some calculated line-profiles have the shape of "P Cygni" or "Wolf Rayet" profiles. On the other hand, quasi-symmetrical line-profiles have been produced, which can be erroneously attributed to "microturbulence" or rotational broadening. (auth)

16526 SINGLE YOUNG OPEN CLUSTER COMPRISING TR 14 AND TR 16. Feinstein, A.; Marraco, H. G.; Muzzio, J. C. (Univ. Nacional, La Plata). Astron. Astrophys., Suppl. Ser.; 12: No. 3, 331-350(Dec 1973).

New photoelectric observations of the open cluster Tr 16, including faint members, and also many stars in and nearby the open cluster Tr 14 were obtained. Tr 16 surrounds the peculiar object η Car. Both clusters and Cr 232 seem to form a single group with very young characteristics. This agrees with the spectral type O3 of the brightest stars in the group as suggested by Walborn (1973). The true distance modulus for the group of clusters, if it is assumed that R = 3.0, is 12.65 ± 0.20 m, equivalent to a distance of d = 3390 ± 300 pc. But the (V−I, B−V) array indicates that it is possible that R = 4.0, in which case the corrected distance modulus is 12.12 m, and the distance of the cluster group decreases to d = 2650 pc. The age of the cluster group is about 3×10^6 years, which is slightly higher than that of the open cluster NGC 6611 used for the definition of the early part of the ZAMS. An inspection of the plotted color excess of each star in its own position in the emission nebula NGC 3372 shows that the clusters and η Car are associated with the dust. Finally it is suggested that there is a close spatial relationship between the emission nebula, the dust, and the stars belonging to the cluster. (auth)

16527 ANALYSIS OF THE ECLIPSING BINARY, AB AND. Rigterink, P. V. (Univ. of South Florida, Tampa). Astron. Astrophys., Suppl. Ser.; 12: No. 3, 313-329(Dec 1973).

Photoelectric observations of the eclipsing binary, AB And, in the B and V wavelength regions are presented. The light curves are compared with previous observations, and the changes in the light curve are noted. New orbital elements are derived using the method of Russell and Merrill and the method of Wilson and Devinney. Differences in the two methods of analysis are discussed. (auth)

16528 NEW GENERAL O TYPE STARS CATALOGUE. Goy, G. (Observatory of Geneva). Astron. Astrophys., Suppl. Ser.; 12: No. 3, 277-311(Dec 1973). (In French).

This catalog is an up to date edition of the Hiltner's catalog (1956b). It contains fundamental data (position, identification, spectral type, polarization, H II region membership). The monographs give all the other informations available until now (binarity, peculiarities, variability etc.). The data concerning the interstellar matter "mass", reddening law, total extinction and intrinsic apparent magnitude) have been presented (Goy 1972) with a first sample of O type stars and will be published for all stars of this catalog. This catalog does not mention typical O stars of the galactic halo, except some stars (like HD 93521) whose position is not too compatible with the disc population but which show the spectroscopic features of the population I. Eight stars (Miller 1972) have been classified O on the basis of colors only. The issue of the present list should stimulate observers to collect homogeneous and accurate measurements of this kind of stars, which is very important for problems bearing on galactic structure. (auth)

16529 CARINA ARM STUDIES. I. Deep Photoelectric UBV Sequences in Vela, Carina, and Crux. Lynga, G.; Wramdemark, S. (Lund Observatory, Sweden). Astron. Astrophys., Suppl. Ser.; 12: No. 3, 365-380(Dec 1973).

Three photoelectric UBV sequences in the southern Milky Way were measured to a limiting magnitude of V = 17.5 m. About 100 stars were observed in each of the three one-degree fields. Comparisons showed good agreement with other UBV observations. (auth)

16530 PHOTOELECTRIC PHOTOMETRY OF STARS NEAR THE NORTH GALACTIC POLE. Haeggkvist, L.; Oja, T. (Astronomical Observatory, Uppsala). Astron. Astrophys., Suppl. Ser.; 12: No. 3, 381-405(Dec 1973).

UBV or BV photometry is presented for 2544 stars, mainly late-type giants, near the North Galactic Pole. (auth)

16531 EQUIVALENT WIDTHS FOR NINE PHASES OF DELTA CEP. van Paradijs, J. (Univ. of Amsterdam). Astron. Astrophys., Suppl. Ser.; 12: No. 3, 407-414(Dec 1973).

A list of wavelengths, identifications, and equivalent widths of spectral lines for nine phases of the variable star δ Cep is presented. (auth)

16532 PALOMAR–GRONINGEN VARIABLE–STAR SURVEY. VI. B and V Observations of Twenty RR Lyrae Variables and Some Related Problems. Plaut, L. (Univ. of Groningen, Netherlands). Astron. Astrophys., Suppl. Ser.; 12: No. 3, 351-363(Dec 1973).

Some results supplementary to the Palomar–Groningen Variable-Star Survey are given. In order to check the magnitude scales and the interstellar absorption in the three fields near l = 0° photoelectric observations in B and V were made for twenty RR Lyrae variables, the local comparison stars and the standard stars. From observations available for bright RR Lyrae the intrinsic color index $(B-V)_0$ at minimum was re-determined and compared with observed $(B-V)_{min}$ of the twenty faint variables. The agreement of these results with the earlier ones is satisfactory. (auth)

16533 PREPARATION OF A SPACE EXPERIMENT INTENDED FOR HIGH RESOLUTION STUDY OF THE FAR ULTRAVIOLET SPECTRUM OF THE STAR GAMMA GEMINI. Valerio, C. Marseille; Univ. Marseille (1972). 104p. (In French).

Thesis.

It was considered of interest to attempt to attribute an atmospheric model to gamma Gemini. This assumed a study in depth of the visible spectrum of the star and also an experimental knowledge of its far ultraviolet spectrum with sufficient resolution. The experiment, with a resolution of 10 A, was intended for observation of the continuous background of the star below 2000 A, also permitting a measurement of the discontinuities of photoionization at 1444 A (carbon) and 1527 A, 1683 A (silicon). An experimental photographic space apparatus is described which was intended to be embarked on the nose cone of the Atlas rocket fired Oct. 16, 1971, from the Kourou base. The adjustment and calibration of the apparatus is described. (IAA)

16534 POLARIZATION MEASUREMENTS IN GALACTIC LATITUDES B LESS THAN –45 DEG. Schroeder, R. Hamburg; Univ. Hamburg (1972). 57p. (In German).

A survey of the measurements conducted for stars with small polarization errors or small angular errors is presented. A table concerning the polarization for each group comprising stars of similar distances is provided. The table shows that starting with a distance of about 90 pc the polarization increases strongly. The angle relative to the galactic center at a distance of about 200 pc is about 74°. (IAA)

16535 OCCULTATION OF THE STAR SAO 93826 BY SATURN'S RING. Albrecht, R. (Univ. Sternwarte, Vienna). Mitt. Astron. Ges.; No. 32, 209-211(18 Sep 1972). (In German).

16536 STRUCTURE OF THE NUCLEUS OF THE OPEN CLUSTER NGC 1245. Popova, M.; Tsvetkov, M. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 6: 47-60(1973). (In Bulgarian).

16537 STAR PHOTOMETRY ON THE PALOMAR ATLAS. Popova, M.; Tsvetkov, M. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 6: 31-46(1973). (In Bulgarian).

Application of photometry to the star pictures of the Palomar Atlas is discussed, with particular attention to the causes of inaccuracies in photometric data obtained by different individual authors. Calibration curves obtained from the Palomar Atlas and the Washington Star Catalog in Sofia and Moscow were examined. Average errors were calculated for the star magnitudes and color indices covered by the study. (IAA)

16538 EFFECTS OF DEPARTURES FROM LOCAL THERMODYNAMIC EQUILIBRIUM ON THE LINE SPECTRUM OF Ap STARS. Wenstrand, D. C. Manhattan, KS; Kansas State Univ. (1973). 131p. University Microfilms Order No. 73-26,381.

Thesis (Ph. D.).

The departures from local thermodynamic equilibrium (LTE) were considered in the ionization equilibrium of the elements silicon, calcium, chromium, iron, and europium for two A-type model atmospheres (8000°K and 10,000°K; log g = 4.0; solar abundances). Significant departures from LTE are found by using ultraviolet radiation temperatures instead of the local electron kinetic temperature in the Saha equation. Thus radiative ionizations are assumed to dominate over collisional ionizations with the photoionization being dominated by ionization from the ground state. It is then shown by detail calculations of the equivalent widths of neutral and singly ionized lines of these elements that abundances determined assuming LTE may be too small, in some cases by as much as a factor of 100. However, for many of the cases considered, the LTE approximation is an adequate assump-

tion for determining the ionization equilibrium. In certain cases, the ultraviolet radiation field is strongly dependent upon the abundances of the opacity sources carbon, silicon, and iron. The possibility that a true abundance anomaly for one of these opacity sources may cause apparent abundance anomalies in Si, Ca, Cr, Fe, and Eu as a result of changes in the ionization equilibrium was investigated. Thus, on the basis of observational abundances, the Ap stars with larger abundances of silicon and iron are closest to an LTE ionization equilibrium, the normal A stars have larger deviations, and a weak-line A star would have the largest departures. (Diss. Abstr. Int., B)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 16502, 16517, and 16689.

16539 EXCITATION OF SEMI-FORBIDDEN $2s^22p^2\ ^3P-2s2p3\ ^5S^0$ AND $2s^22p\ ^2P^0-2s2p^2\ ^4P$ LINES OBSERVED IN QUASARS. Jackson, A. R. G. (Coll., London). J. Phys., B (London); 6: No. 11, 2325-2333(Nov 1973).

Collisional excitation by free electrons, of transitions in various ions of the type $2s^22p_q-2s2p^{q+1}$, determines the strength of many semi-forbidden lines observed in quasars. Collision strengths for the transitions N^+ and O^{2+} $2s^22p^2\ ^3P-2s2p^3\ ^5S^0$, and N^{2+} $2s^22p\ ^2P^0-2s2p^2\ ^4P$ are calculated from solutions of coupled integro-differential equations. In all cases allowance is made for configuration interaction between $2s^22p_q$ and $2p^{q+2}$, and all $2s2p^{q+1}$ channels are included. (auth)

16540 INTERPRETATION OF THE HUBBLE DIAGRAM FOR QUASARS. Stannard, D. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Nature (London); 246: No. 5430, 295-297 (30 Nov 1973).

It has been stated that the large scatter in the composite Hubble diagram for quasars may be greatly reduced if only quasars with steep radio spectra and extended structures are considered (Astrophys. J. Lett. 181: L, 61 (1973)). For the latter type of quasar there is a marked correlation between apparent optical magnitude and redshift, with a slope similar to that found for normal radio galaxies and the brightest galaxies in clusters. The absence of such a correlation for quasars with flatter spectra may be attributed either to a broader dispersion in luminosity or to redshifts that are intrinsic to the source rather than a measure of cosmological distance. In the present communication consideration is given in detail to the form of the radio spectra of a sample of 166 quasars of known angular size and redshift, taken from data in the published literature, supplemented by recent observations made at Jodrell Bank and NRAO, Greenbank. The three main categories considered are flat spectrum, concave spectrum, and steep spectrum (straight or convex). A striking correlation is found between spectral type and radio structure. The Hubble diagram for the steep spectrum quasars in the sample shows a significant correlation between apparent magnitude and redshift, and this also applies to quasars with flat spectra considered on their own. The data for both steep and flat spectrum quasars are consistent with a Hubble slope of 5 mag per decade of redshift, and although such a slope is not conclusive evidence for cosmological redshifts, it is the value predicted on a Friedmann cosmology. Hubble diagrams are shown for quasars with flat and concave radio spectra. It is not clear why quasars with concave spectra should be a major class that fails to show a significant Hubble relationship. One possible explanation for the apparent steepness of the correlation between magnitude and redshift could be luminosity evolution in the sense that high redshift quasars with concave spectra have systematically greater luminosities than those at low redshift. An optical absorption peculiarity associated with concave spectrum quasars is attributed to the recent expulsion of material from the active nuclei. (UK)

16541 UPPER LIMIT FOR THE PULSED EMISSION ABOVE 100 KeV FROM HERCULES X-1. Kurfess, J. D.; Crosa, L. (Naval Research Lab., Washington, DC). Nature (London) Phys. Sci.; 245: No. 147, 116(22 Oct 1973).

A search is reported for 1.24 sec. pulsed emission above 100 keV from the binary x-ray source Hercules X-1. The observations were made from a balloon flight on February 19, 1972, from Palestine, Texas, at a float altitude of ~129,000 ft., using an unshielded NaI(Tl) detector: since the detector was omnidirectional the experiment was sensitive only to pulsating sources. No evidence was found for a pulsed emission. A 2σ upper limit of 3.4×10^{-3} photons/cm^2/sec. for a pulsed emission, in the 0.1 to 10 MeV energy interval, was obtained. (UK)

16542 DECREASE IN BINARY PERIOD OF CENTAURUS X-3 AND POSSIBLE IMPLICATIONS IN TERMS OF MASS LOSS. Van Den Heuvel, E. P. J.; De Loore, C. (Univ., Brussels). Nature (London) Phys. Sci.; 245: No. 147, 117-118(22 Oct 1973).

A decrease in the orbital of Cen X-3 amounting to about 5 sec. in 20 months has been reported. It is pointed out here that mass loss seems a natural explanation for the decrease. The x-ray emitting component in the Cen X-3 system is most likely to be a neutron star, and the other component is expected to be a post main-sequence star with $M \geq 15\ M_\odot$, overflowing its Roche lobe. The outer H-rich layers of the lobe-filling component of a binary are expected to be expelled on a thermal time scale that for a $15\ M_\odot$ star is of the order of 3×10^4 yr., corresponding to a maximum mass loss rate of $\sim 3 \times 10^{-4}\ M_\odot$/yr. It is concluded that, in terms of mass loss, the observed rate of decrease of the binary period of Cen X-3 seems difficult to reconcile with a conventional stellar wind type of mass loss, but is compatible with mass transfer from the primary towards the neutron star, possibly followed by ejection out of the system at a rate of $\sim 10^{-5}\ M_\odot$/yr. (UK)

16543 DEEPENING QUASAR MYSTERY. Hazard, C.; Mitton, S. (Cambridge Univ., Eng.). New Sci.; 60: No. 874, 633-635(29 Nov 1973).

The properties of quasars are outlined and the apparent difficulties which have arisen in the assumption that they are extremely distant objects, leading to questioning of the Hubble law, are considered. Quasars appear to be at odds to the Hubble law because they have extremely large redshifts. The majority of astronomers take the traditional view that quasars are truly cosmological obeying Hubble's law. A small group, however, has questioned this stand, preferring to treat quasars as puzzling anomalies that are not extremely distant. Arguments on both sides are examined. One difficulty in resolving the impasse is the lack of a sufficiently large sample of quasars. Most investigations have been made on bright objects, but the properties of these may not be typical of quasars in general. To rectify this situation a group of astronomers from several different countries has worked on the production of a list of new quasars. Some two dozen people have been involved with various facets of this recent quasar search, which is still continuing. Results already obtained from this project are given. High redshifts and "discrepant" redshifts, that is quasars whose measured redshifts do not appear entirely consistent with the traditional cosmological interpretation have been reported. The most convincing case for a quasar-cluster association is provided by 4C 24.23, where a compact blue object, the quasar, is nestling at the edge of a neat cluster of five faint galaxies. The most intriguing results of all however are those for 4C 11.50, a close pair of blue starlike objects, separated by only 5 secs of arc. (UK)

16544 ACCELERATION OF PARTICLES IN EXTENDED NONTHERMAL SOURCES. Pacini, F. (Laboratorio di Astrofisica Spaziale, Frascati, Italy); Salvati, M. Astrophys. Lett.; 15: No. 1, 39-41(Sep 1973).

Polarization measurements are compatible with the idea that the Crab Nebula, and possibly other sources as well, are filled with low-frequency waves propagating in a much stronger static field. The presence of this static field decreases the maximum energy which the waves can impart to particles at rest from $\gamma_{max} \sim (eH/mc\Omega)^2$ to $\gamma_{max} \sim (eH/mc\Omega)$. The astrophysical aspects of this situation are briefly discussed. (auth)

16545 ANGULAR DIAMETERS OF QUASARS AND COSMOLOGY. van der Kruit, P. C. (Hale Observatories, Pasadena, CA). Astrophys. Lett.; 15: No. 1, 27-33(Sep 1973).

A critical discussion is given of the inferences drawn from the angular diameter distribution of quasars. Further evidence is given that the distribution with redshift is compatible with evolving universes with physical diameter evolution. The apparent gap in the linear size distribution around 200 kpc might very well be caused by observational effects. Rowan-Robinson's proposition that some quasars are local is examined. It rests mainly on the uniform V/V_m distribution for small-diameter 3CR quasars and their association with peculiar galaxies and Zwicky clusters. It is found that "compactness" of the radio spectra is a better criterion than linear size and that the V/V_m distribution is uniform for a 3CR sample only with respect to its optical and radio detection limits. Associations of extragalactic 3CR sources with Zwicky clusters show a "random" distribution for quasars. Compact quasars are not significantly members of Arp's pairs across galaxies. There is as yet no convincing evidence from the angular diameters of quasars that some of them are not cosmological. (auth)

16546 OPTICAL CANDIDATES FOR THE X-RAY SOURCE GX5-1. Reina, C. (Univ., Milan); Tarenghi, M. Astrophys. Lett.; 15: No. 1, 7-8(Sep 1973).

The large distance of GX 5-1, suggested by the low-energy

x-ray spectrum, restricts the number of possible optical candidates. A near infrared excess from the counterpart is expected. (auth)

16547 POLARIMETRIC OBSERVATIONS OF NONSTABLE STARS AND EXTRAGALACTIC OBJECTS. III. Polarization of Quasars and Galactic Nuclei. Efimov, Yu. S.; Shakhovskii, N. M. Izv. Krym. Astrofiz. Observ.; 46: 3-13(1972). (In Russian).

The results of multicolor polarimetric observations of some quasars, N-galaxies, compact galaxies, and nuclei of Seyfert galaxies obtained in 1969–1970 with the 2.6-meter reflecting telescope, are presented. It was found that the polarization of quasar 3C 345 reached 45% during its flash in June 1969. Sometimes, a very large polarization (more than 20%) of the N-galaxies 3C 371 and 3C 390.3 takes place in the blue region as well as very sharp and nonmonotonous wavelength dependence of the degree and position angle of polarization. Apparently it may be during the time of their flashes. The quasar 3C 273 and Seyfert galaxies NGC 4051, 4151, and 5548 also show the dependence of the position angle of polarization on the wavelength. To explain the wavelength dependence observed one needs to suppose that the light of different colors originates in different volumes having different orientation of magnetic field. The other possibility is the difference in mechanisms of polarization for different spectral regions. (auth)

16548 SELECTION EFFECTS AND THE NATURE OF QSO redshifts. Karlsson, K. G. (Uppsala Univ.). Nature (London) Phys. Sci.; 245: No. 144, 68-70(1 Oct 1973).

It has been stated that the observed distribution of QSO redshifts can be interpreted in terms of a selection effect due to the different number of search lines available at different redshifts. The present author gives reasons why this finding should be treated with caution. (UK)

16549 UPPER LIMITS ON THE SOFT X-RAY SPECTRA OF 3C 273 AND NGC 4151. Zaumen, W. T.; Catura, R. C.; Fisher, P. C. (Lockheed Palo Alto Research Lab., CA). Astron. Astrophys.; 28: No. 3, 467-468(Nov 1973).

Three-sigma upper limits on the x-ray spectra of 3C 273 and NGC 4151 were determined in the energy region 0.5 to 2.4 keV. These upper limits were of the order of 0.1 photons/cm^2/s/keV. (auth)

16550 MASS LIMIT OF THE X-RAY SOURCE IN CYGNUS X-1. Mauder, H. (Univ., Tuebingen, Ger.). Astron. Astrophys.; 28: No. 3, 473-475(Nov 1973).

Limiting values for the mass of the x-ray emitting source in Cygnus X-1 are derived without an initial assumption on the mass of the primary of HDE 226868. It is shown that the model of Trimble et al. (1973) with a low mass, low surface gravity B0I star is in contradiction to the observations. The heating effect on the facing hemisphere of the OB star by the x-rays of the secondary is shown to be negligible in accordance with the observations. The mass function and the Roche geometry set lower and upper limits, respectively, on the mass of the secondary. According to these restrictions the mass of the x-ray source most probably is $6.0 \lesssim M_X/M_\odot \lesssim 7.3$, thus giving evidence for the existence of a black hole in Cygnus X-1. (auth)

16551 GRAVITATIONAL SLOWING DOWN OF SOLID SPINNING BODIES. Bertotti, B.; Anile, A. M. (Oxford Univ.). Astron. Astrophys.; 28: No. 3, 429-432(Nov 1973).

The dynamics of a solid body subject to the gravitational reaction torque were studied. There are three time scales; the period $2\pi/\omega$, the precession period $2\pi/\Omega$, and the slowing down time ν^{-1}; they stand in the relation $\omega \gg \Omega \gg \nu$, so that it is essential to consider the precessional motion. The problem for a rigid, axially symmetric body and for an elastic body was studied, in which the equatorial bulge can follow the instantaneous rotation axis to an arbitrary amount. If the body is rigid enough, the precession angle θ diminishes monotonically; but elastic behavior may instead increase θ to $\pi/2$. When θ vanishes the radiation stops. (auth)

16552 HARD X-RAY FLARE-LIKE ACTIVITY IN THE CYG X-1 EMISSION. Fuligni, F.; Frontera, F. (Space Research Group of the Laboratorio Tesre, Bologna). Astron. Astrophys.; 28: No. 3, 373-377(Nov 1973).

Preliminary results of a balloon observation of Cyg X-1, made on June 1972, are reported. Search for time variations in the intensity over time periods of minutes was performed. No such fluctuations of the flux, in the energy range 20 to 200 keV, appeared to exist at the time of this measurement. A lower state of the flux, corresponding to a softening of the spectrum, was detected at energies between 100 and 200 keV. This state had a duration of at least 15 minutes. At the same time a flare-like event was present, well detectable at energies below 100 keV, during which the intensity varied in about 2 minutes by a factor 1.8 in the range 40 to 100 keV. (auth)

16553 STEADY ENERGY SOURCE IN HER X-1. Avni, Y.; Bahcall, J. N.; Joss, P. C.; Bahcall, N. A.; Lamb, F. K.; Pethick, C. J.; Pines, D. (Inst. of Advanced Study, Princeton, NJ). Nature (London) Phys. Sci.; 246: No. 151, 36-37(19 Nov 1973).

It is stated that observations of the Her system have been interpreted in terms of HZ Her being a late A or early F star which has a bright side as a result of heating due to radiation from Her X-1. The question is discussed as to whether the heating of HZ Her is (1) due to the observed pulsed 2- to 40-keV x-rays from Her X-1, or whether (2) some additional source of energy associated with Her X-1 must be postulated to explain the observed optical behavior of HZ Her. The observational facts are examined and it is concluded that it is difficult to explain the optical observations on the basis of possibility (1) above. On the other hand if there exists a steady source of soft x rays or an unpulsed uv source that follows Her X-1 in its orbital motion about HZ Her, certain puzzling features of the optical observations can be understood. Arguments are advanced that suggest the existence of such a source, and the properties of such a source are discussed. With regard to physical models, two possibilities for the additional energy source are a heated disk or ring of matter surrounding the compact star, and orbiting with it around HZ Her, or nuclear burning of accreted matter below the surface of the compact star. Several possible observations bearing directly on the problems are suggested, together with observations that would provide indirect evidence for the additional steady energy source. (UK)

16554 NARROW BAND FILTERS FOR THE FAR INFRARED. Wijnbergen, J. J. (Kapteyn Astronomical Inst., Groningen, Netherlands). Astron. Astrophys.; 29: No. 1, 159-161(Nov 1973).

For astronomical photometry Fabry–Pérot filters were constructed by applying inductive meshes. The filters can be made at specified wave numbers for the far infrared below 500 cm^{-1}. A short description of the method of construction is given together with some measured data. (auth)

16555 LONG TERM VARIABILITY IN HZ Her–Her X-1 BINARY SYSTEM. Lin, D. N. C. (Inst. of Astronomy, Cambridge, Eng.). Astron. Astrophys.; 29: No. 1, 109-111(Nov 1973).

Previous models proposed for the long-term variability of the hard x-ray emission from Her X-1 are not consistent with the behavior of the associated HZ Her optical source. This note describes a new mechanism that could explain the basic features of both the optical and the x-ray behavior of the HZ Her–Her X-1 binary system. In the proposed model, the hard x-ray emission due to accretion onto the neutron star secondary is cut off periodically, not as a result of a reduction of the matter influx through the lagrangian point from the primary (as in the previous models), but rather as a result of an excess influx from the primary. When the influx exceeds the critical amount which can be accepted by the neutron star, the excess material is ejected to form an outgoing cloud which absorbs and degrades the hard x rays, so that the accretion energy is finally emitted in the form of soft x rays. In this model the total luminosity, and hence the rate of heating of the primary, do not vary significantly as the hard x rays are switched on and off. (auth)

16556 GALACTIC X-RAY SOURCES. Schreier, E. J. (Harvard College Observatory, Cambridge, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 650-667(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The relevance of galactic x-ray astronomy to the study of compact stellar objects is discussed. After some general remarks about x-ray astronomy, a brief picture of the x-ray sky is presented. Finally, a more detailed discussion of two specific galactic x-ray sources is presented. Observations of Cygnus X-1 and Hercules X-1 are discussed in the light of their possible identification with a black hole and a neutron star respectively. (auth)

16557 COMPACT H II REGIONS NEAR THE OH SOURCE ON-2. Matthews, H. E. (Kapteyn Astronomical Inst, Groningen, Netherlands); Gross, W. M.; Winnberg, A.; Habing, H. J. Astron. Astrophys.; 29: No. 2, 309-314(Dec 1973).

A region near the class I OH maser OH 75.8 + 0.3 (ON-2) was observed at 4.995 GHz at Westerbork and at 10.7 GHz at Effelsberg. Two compact H II regions were detected at 2.8 cm. At 6 cm a third source was found with a diameter less than 4'' and a flux of about 40 mfu; the position is within several arcsec of the OH source. It is suggested that this association is quite similar to the cases of G 133.9 + 1.1 (W3 – OH) and G 69.5 – 1.0 (ON-1). An expression for the minimum mass of an unresolved H II region is given. (auth)

16558 TWO COLOR FAR INFRARED PHOTOMETRY OF SOME GALACTIC H II REGIONS. Olthof, H.; van Duinen, R. J.

(Kapteyn Astronomical Inst., Groningen, Netherlands). Astron. Astrophys.; 29: No. 2, 315-320(Dec 1973).

Results are presented of a far infrared photometric measurement of H II regions in two wavelength bands simultaneously. The intensities obtained with a 0.5 degree beam are in general higher than previously observed by Hoffman et al. (1971). A model is proposed for relating the infrared fluxes to the uv fluxes, deduced from radio continuum observations. In this model the ratio of both fluxes is a measure of the temperature of the exciting central sources. (auth)

16559 MICROWAVE CHARACTERISTICS OF OH 0739-14 AND THE PLANETARY NEBULA NGC 2438. Goss, W. M. (Univ. of Groningen, Netherlands); Nguyen-Quang-Rieu; Winnberg, A. Astron. Astrophys.; 29: No. 3, 435-439(Dec 1973).

A search for weak continuum radio emission in the direction of OH 0739-14 was made using the Westerbork Synthesis Radio Telescope and the 100-m Radio Telescope at Effelsberg. No emission greater than 6 mfu and 30 mfu was found at 1.4 GHz and 10.7 GHz respectively. Weak 1612 MHz OH emission was detected; it is the counterpart of the narrow 1667 MHz feature previously found by Turner. The nearby planetary nebula NGC 2438 was also observed at 1.4 GHz and 10.7 GHz. The radio source was resolved in right ascension at 1.4 GHz; the corresponding angular size was 42″. No 1667-MHz OH emission stronger than 0.1 fu was detected in the direction of the nebula. (auth)

16560 PULSAR CAVITY RADIATION. Monaghan, J. J. (Univ. of Colorado, Boulder). Astron. Astrophys.; 29: No. 3, 383-386 (Dec 1973).

The low-frequency dipole radiation from a rotating, magnetic neutron star can drive out a cavity surrounding the star. The character of the radiation field within the cavity is examined assuming the reflection is nearly perfect. It is argued that in a nonspherical cavity the radiation will travel a quasi-ergodic route eventually becoming isotropic and the cavity eventually spherical. In the spherical cavity, standing waves form in the wave zone. The simple picture of particle acceleration in the outgoing radiation fails. The radiation is focussed to the neutron star where, at the velocity of light radius, the focussed fields dominate over the direct fields. A brief discussion is given of the new effects expected if the neutron star is a member of a binary. (auth)

16561 LINE AND CONTINUUM SYNTHESIS OF W3. Sullivan, W. T. III (Kapteyn Astronomical Inst., Netherlands); Downes, D. Astron. Astrophys.; 29: No. 3, 369-375(Dec 1973).

Synthesis maps of the continuum and H I and H 166α lines from the H II region W3 were made at 1.4 GHz with the Westerbork Telescope. Ten continuum components were found with sizes ranging from $<20''$ to $100''$. The flux density of the source W3 (OH) was three times greater than expected from measurements at higher frequencies, a result which suggests the presence of a second component. With one exception all of the sources in W3 showed the same amount of absorption by neutral hydrogen when observed with filter widths of 27 km s^{-1}. A probable detection of the H 166α line in W3 A yielded $T_L/T_C = 0.004 \pm 0.001$. The He and C 166$\alpha$ lines were not detected, which suggests that the He and C radiation seen with single antennas cannot come from one region of size $<0.7'$. At 1.4 GHz, most of the hydrogen recombination-line emission seen with single antennas arises not in the high-density compact sources, but rather in the low-density component of angular extent $>5'$. This result supports the interpretation of radio recombination lines given by Brocklehurst and Seaton (1972). (auth)

16562 QUASAR SCINTILLATIONS AT AN INHOMOGENEOUS INTERSTELLAR PLASMA. Vitkevich, V. V.; Shishov, V. I. pp 42-45 of Stellar Atmospheres and the Interplanetary Plasma. Moscow; Izdatel'stvo Nauka (1972). (In Russian).

16563 VARIATIONS OF PULSAR INTENSITY AS A RESULT OF SCINTILLATIONS AT AN INHOMOGENEOUS PLASMA. Vitkevich, V. V.; Lotova, N. A. pp 46-52 of Stellar Atmospheres and the Interplanetary Plasma. Moscow; Izdatel'stvo Nauka (1972). (In Russian).

16564 CURRENT OBSERVATIONAL PROBLEMS IN ASTRONOMY. Strittmatter, P. A. (Steward Observatory, Tucson, AZ). pp 1-4 of Astronomical Observations with Television-Type Sensors. Vancouver, B. C.; Univ. of British Columbia (1973).

Problems of optical and uv astronomy connected mainly with the study of quasars are discussed. Several observational requirements of new detections are pointed out, and the urgency of closest teamwork between astronomers and instrumentalists is emphasized. (IAA)

16565 RADIATIVE ACCELERATION OF MATERIAL. Weymann, R. (Univ. of Arizona, Tucson). Comments Astrophys. Space Phys.; 5: No. 5, 139-150(1973).

Several papers in astronomical literature have dealt with the ejection of material from a self-gravitating body (stars and quasars) under the action of radiation pressure. The question considered in this paper is whether radiative acceleration of material can produce the very sharp, highly-displaced absorption lines typified by PHL 938, PHL 957, PKS 0237-23, H 1331 + 170, Ton 1530, and 4C05.34. (WDM)

16566 STATISTICAL PROPERTIES OF EXTRAGALACTIC RADIO SOURCES. Saslaw, W. C.; Mitton, S. Comments Astrophys. Space Phys.; 5: No. 5, 133-138(1973).

Information presently available in the statistical study of extragalactic radio sources falls into three categories: basic source geometry; radio flux densities and spectra, and polarization. These categories are briefly considered. (WDM)

Solar Phenomena

Refer also to abstracts 16712, 16731, 16733, and 17162.

16567 (BMBW-FB-W-72-27) SOLAR OBSERVATIONS AND RESEARCH WITH ROCKETS. Schmidtke, G. (Zentralstelle fuer Luft- und Raumfahrtdokumentation und -information, Munich (F. R. Germany)). Aug 1972. 124p. (In German). NTIS (U. S. Sales Only).

A survey of current space programs in solar research and observation in the FRG is given. Special projects such as the spectro-stratoscope, x-ray images of the Sun, high resolution xuv spectroscopy with diffraction filter techniques etc. are discussed in more detail. Taking important international research programs such as ATM, OSO, and HELIOS into consideration, significantly rewarding projects for future solar research are outlined. Presently available solar pointing controls are reviewed concerning their technical possibilities. In conclusion recommendations for the national research program have been derived. (auth)

16568 (CONF-720535-, pp 181-185) MOTIONS OF NEW AND OLD SPOT GROUPS IN THE LARGE SCALE FLOW OF THE SOLAR PHOTOSPHERE. Fischer, H. J. E. (Detachment 6, 6th Weather Wing, Bedford, MA). 1972.

From international conference on aerospace and aeronautical meteorology; Washington, District of Columbia, USA (22 May 1972).

International conference on aerospace and aeronautical meteorology.

The proper motions of sunspot groups as a function of their age were investigated. Proper motion refers to the zonal component of motion after the mean solar rotation rate (assumed invariant with latitude) is substracted from the daily spot group displacements. (WDM)

16569 (N-72-21831) REDUCTION AND ANALYSIS OF PARTICLE DATA FROM IMP F (EXPLORER 34) AND IMP G (EXPLORER 41). Final Report, June 1965–December 1971. Brown, W. L. (Bell Telephone Labs., Inc., Murray Hill, N. J. (USA). Radiation Physics Research Dept.). 31 Dec 1971. Contract NAS5-9102. 249p. (NASA-CR-122389). NTIS.

This report consolidates material prepared by investigators who participated in the analysis of particle data acquired by particle detection equipment on Explorer 34 and Explorer 41 satellites. Results of studies concern the propagation and composition of solar flare particles measured in the interplanetary space by the two satellites. (STAR)

16570 (N-73-14810) SOLAR WIND PHOTOPLATE STUDY. Final Report, June 1970–July 1972. Scott, B. W.; Voorhies, H. G. (Perkin-Elmer Corp., Pomona, Calif. (USA). Aerospace Div.). Nov 1972. 88p. (NASA-CR-130134). NTIS $6.50.

An ion sensitive emulsion detection system has been considered for use in a cycloidal focusing mass spectrometer to measure the various atomic species which comprise the solar plasma. The responses of Ilford Q2 and Kodak SC7 emulsions were measured with N II ions at 6 keV to 10 keV. He III ions at 750 eV to 2500 eV, and H II ions at 550 eV to 1400 eV. These ions have the approximate range of velocities (about 300 to 500 km/sec) encountered in the solar wind. The work was carried out on a specially prepared magnetic sector mass analyzer. Characteristic response curves were generated, each one utilizing approximately 50 data points at three or more current densities. In addition to the ion response, measurements of the response of these emulsions to a photon flux simulating the visible portion of the solar spectrum were made. The results obtained will be presented in detail and interpreted in relation to other data available for these emulsions. (STAR) (auth)

16571 (N-73-30769) EMPIRICAL MODEL OF ENERGETIC SOLAR PROTON FLUXES WITH APPLICATIONS TO EARTH ORBITING SPACECRAFT. Stassinopoulos, E. G.; King, J. H. (Na-

tional Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Dec 1972. 33p. (NASA-TM-X-70433; X-601-72-489). NTIS $3.75.

An empirical model for energetic solar proton fluxes is presented. With this model, the effects of such protons on geocentric space missions, to be flown during the next solar active period (1966–1983) and with orbits involving partial magnetospheric shielding, may be estimated. A synoptic background review is given, followed by a detailed discussion of the model's analytic development. Also given are comments on the model's use, errors, uncertainties, and limitations, including sample calculations which demonstrate the application of specific or general project missions. Finally, for circular trajectories, percentage exposure maps are presented, depicting fractional mission times spent outside particular L-shells as functions of orbit altitude and inclination. (STAR) (auth)

16572 (N-73-30776) STABILIZATION OF ELECTRON STREAMS IN TYPE 3 SOLAR RADIO BURSTS. Papadopoulos, K.; Goldstein, M. L.; Smith, R. A. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). May 1973. 31p. (NASA-CR-133844; BN-770). NTIS $3.75.

It is shown that the electron streams that give rise to Type 3 solar radio bursts are stable and will not be decelerated while propagating out of the solar corona. The stabilization mechanism depends on the parametric oscillating two-stream instability. Radiation is produced near the fundamental and second harmonic of the local electron plasma frequency. Estimates of the emission at the second harmonic indicate that the wave spectra created by the oscillating two-stream instability can account for the observed intensities of Type 3 bursts. (auth)

16573 (N-73-31639) COHERENT PROPAGATION OF CHARGED PARTICLE BUNCHES IN RANDOM MAGNETIC FIELDS. Earl, J. A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Apr 1973. 67p. (NASA-CR-135492). NTIS.

When the distribution function for energetic particles moving in interplanetary space is expressed in terms of eigenfunctions of an operator which describes pitch angle scattering by random magnetic fields, the familiar phenomenon of diffusion is the dominant solution of the transport equations provided that the spectrum of magnetic fluctuations is not too steep. However, if the power vs. wavenumber spectrum of the random fields has a spectral index $q > 2$, the dominant solution of the same equations is a qualitatively different mode of transport in which density inhomogeneities propagate coherently along the guiding field with a characteristic velocity equal to half the particle speed. Extended classical transport theory is used to give a detailed treatment of the new mode and to present formulas which describe the spatial and temporal structure of the coherent disturbance. (STAR) (auth)

16574 (N-73-31710) IMPULSIVE SOLAR X-RAY BURSTS: BREMSSTRAHLUNG RADIATION FROM A BEAM OF ELECTRONS IN THE SOLAR CHROMOSPHERE AND THE TOTAL ENERGY OF SOLAR FLARES. Petrosian, V. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jun 1973. 31p. (NASA-CR-133943; SU-IPR-528). NTIS $3.75.

Analysis of various aspects of impulsive x-ray bursts (IXB's) has lead to the consideration of a model where the x rays are produced by bremsstrahlung radiation from a beam of electrons directed toward the photosphere. It was found that in general the x-ray spectrum from such a beam will fall off more rapidly than when the effect of the beaming of radiation is neglected. Furthermore, the spectral index of the resulting x rays appears to increase by about unity for x-ray energies >100 keV, a fact which may explain the observed cutoff in the spectrum of the IXB's. It is also shown that in such a model there is sufficient energy in the form of nonthermal electrons to explain the total energy ($\sim 10^{32}$ ergs) of a flare. (STAR) (auth)

16575 ACCELERATION AND INJECTION OF HIGHLY RELATIVISTIC ELECTRONS DURING THE AUGUST 7, 1972, SOLAR FLARE. Maccagni, D. (Consglio Nazionale delle Richerche, Milan); Perotti, F.; Villa, G.; Cherki, G.; Raviart, A.; Treguer, L. Nature (London); 246: No. 5430, 300-301(30 Nov 1973).

It is stated that the 3B flare of August 7, 1972 was one of the largest of the present solar cycle, and thanks to the favorable conditions for particle propagation and to the time of day it occurred, a large quantity of data is available. Highly relativistic electrons from the flare have been observed in outer space by spacecraft. The time profile of the onset of the flare electrons is shown graphically and the time history of relevant phenomena that occurred on August 7th is shown schematically. The GHz radio bursts and the hard x-ray emission are sure signs of relativistic electrons moving in the solar magnetic fields, and the magnetic field in which the electrons radiate must have been of the order of 1000 gauss. Several accelerations appear to have taken place during the ~10 min. rise time of the radio and x-ray bursts, each acceleration lasting less than 1 min. This multiple acceleration cannot, however, explain the time lag on the Earth between protons and electrons. If a very fine structure of the interplanetary magnetic field is not responsible for the delay in arrival time of the first electrons, these must spend 5 to 10 min. after acceleration in the solar corona, in a region where radiation energy losses are not large. This implies that since the times of acceleration and of injection into interplanetary space may not always coincide care must be taken in applying propagation theories to solar particle events. Furthermore, if the time delay in the onset of the relativistic electrons means that they spend this time in the solar corona, not only their injection time but also the longitude of injection can be different from that of the protons. (UK)

16576 BRIGHTNESSES AT DIFFERENT LEVELS IN THE SOLAR ACTIVE REGIONS. Gopasyuk, S. I.; Tsap, T. T. Izv. Krym. Astrofiz. Observ.; 46: 90-100(1972). (In Russian).

Relations between the brightness of different lines and between the brightness and magnetic fields at different levels in active regions are studied. The records of magnetic fields and brightness were made in the Ca II K_3, H_α, H_β, H_γ, H_δ, λ4227 Å Ca I, λ5184 Å Mg I, Na I D_1, λ 5250 Å Fe I lines and in continuous spectrum λ6100 Å with the double magnetograph. The distributions of the brightness in active regions of all spectral lines and of the continuous spectrum were compared with distribution in H_α. It was found that the brightness in all lines except H_β, H_γ, H_δ and in continuous spectrum increased with H_α-brightness. There were two types of behavior of brightness in the case of hydrogen lines for low values of H_α-brightness (1.0 to 1.1). In the first case the brightness in H_β, H_γ, and H_δ increased with H_α-brightness. In the second case the brightness in H_β, H_γ, H_δ first decreased and then increased with the increase of the H_α-brightness. The brightness excesses were used to estimate the temperature excesses in active regions. The temperature excesses increased with the increase of the magnetic field strength (except sunspots). (auth)

16577 HEATING OF THE SOLAR ACTIVE REGIONS. Gopasyuk, S. I.; Tsap, T. T. Izv. Krym. Astrofiz. Observ.; 46: 101-105(1972). (In Russian).

The heating of the solar active regions by shock waves, hydromagnetic waves, and Joule losses in partially ionized gas is considered. It is shown that Joule heating plays the most important role in the heating of active regions. (auth)

16578 INTERPRETATION OF THE TOTAL MAGNETIC VECTOR MEASUREMENTS IN SUNSPOTS. Kotov, V. A. Izv. Krym. Astrofiz. Observ.; 46: 115-127(1972). (In Russian).

Great change of magnetic field with the depth in the spot was found on the basis of the total vector H-measurements at two levels corresponding to the depths of the λ5250 Fe and λ6103 Ca I line-formation. The spiraling of the horizontal field and its rotation with depth were observed in the spot area where the vertical field increased with height. The densities of vertical and horizontal electric currents in the spot were equal to $\sim 5.10^3$ and $\sim 10^5$ CGSE respectively. The considerable discrepancy between the height gradients of vertical field inside the spot was obtained (1) from the measured vertical field at two levels ($\sim \pm 3$ g/km) and (2) from the use of the equation div H = 0 ($\sim \mp 0.5$ g/km). It points on the difficulties of the usual interpretation of H-recordings in spots. The conclusion is drawn that this discrepancy could be mostly attributed to the difference (by more than one order of magnitude) between a very high depth and low surface resolutions. (auth)

16579 DISTRIBUTION OF THE RADIOBRIGHTNESS NEAR THE SOLAR LIMB FROM THE OBSERVATIONS OF THE SOLAR ECLIPSES ON THE 22nd OF SEPTEMBER 1968 AND THE 7th OF MARCH 1970 AT WAVELENGTH OF 10 CM. Nikolaev, N. Ya.; Yurovskii, Yu. F. Izv. Krym. Astrofiz. Observ.; 46: 128-135 (1972). (In Russian).

It was found from observations of the solar eclipses on the 22nd of September 1968 and the 7th of March 1970 that quiet regions of the solar disk had brightness temperature of $40 \cdot 10^3$ °K at 10 cm. The brightness distribution of the quiet Sun showed a maximum outside the limb extending to a height of $20 \cdot 10^3$ km. The maximum had a temperature of $145 \cdot 10^3$ °K and $275 \cdot 10^3$ °K on the 22nd September 1968 and on the 7th of March 1970 respectively. The presence of the extensive prominence in the region of first contact at 22nd of September 1968 was considered to be the possible cause of smaller limb-brightening. The height of local sources at 10 cm were about $60 \cdot 10^3$ km but the region of maximum brightness layer was at $20 \cdot 10^3$ km above the photosphere. (auth)

16580 SOME CHARACTERISTICS OF THE LOCAL RADIO SOURCES FROM THE OBSERVATIONS OF THE SOLAR ECLIPSE ON THE 7th OF MARCH 1970 IN CUBA. Yurovskii, Yu. F.; Yurovskaya, L. I. Izv. Krym. Astrofiz. Observ.; 46: 136-143 (1972). (In Russian).

The analysis of the observational data received during solar eclipse on the 7th of March 1970 has shown that the sources of S-component at the wavelength 10 cm correspond to all sunspots. The maximum radio emission above unipolar sunspots do not show apparent displacement relative to the radius passing through the center of these sunspots. In complex groups the brightest part of radio source is displaced from the preceding sunspot to following smaller ones which are of the opposite polarity. Two sources of noise storm were found at wavelength 1.37 m. The noise bursts regions didn't coincide on the disk of Sun with the regions of continuum but were located just beside them. (auth)

16581 SOLAR ROTATION AND THE NEUTRINO FLUX. Demarque, P.; Mengel, J. G.; Sweigart, A. V. (Yale Univ., New Haven). Nature (London) Phys. Sci.; 246: No. 151, 33-35(19 Nov 1973).

Some possible mechanisms for producing a low neutrino flux from solar models are discussed. Rapid internal rotation is shown to reduce the predicted neutrino flux to the upper limit observed by Davis. (auth)

16582 COLLISIONAL BROADENING OF THE SOLAR SODIUM D LINES. Worrall, G. (Inst. of Astronomy, Cambridge, Eng.). Astron. Astrophys.; 29: No. 1, 37-41(Nov 1973).

The center-limb variation of intensity in the wing of the solar, sodium D_1 line was analyzed to find the ratio of the line to continuum absorption coefficient as a function of wavelength shift and depth. The line absorption coefficient varies as $1/\Delta\lambda^2$, and, interpreting the variation with depth in terms of the Harvard Smithsonian Reference Atmosphere, the linear variation of the broadening parameter with density of hydrogen atoms is apparent. Using the recent calculations of broadening coefficients by Lewis et al. the abundance of sodium relative to hydrogen by number of atoms is $(2.15 \pm 0.2) \times 10^{-6}$. (auth)

16583 SOLAR WIND INTERACTION WITH H_2O COMETS. Wallis, M. K. (Oxford Univ.). Astron. Astrophys.; 29: No. 1, 29-36(Nov 1973).

The solar wind's penetration of a cometary atmosphere is described as an ionizing flow, whose scale length is given by the critical (sonic) position in a one-dimensional approximation. The description is applied to the supersonic flow ahead of the bright comets Bennett and Tago-Sato-Kosaka, on the assumption that H_2O was the sole basic constituent. Examination of the various dissociative and ionizing processes leads to the flow scale 2 to 3×10^5 km: at this distance ahead of the comet, a weak, resistive shock is predicted. In the "old" periodic comet Encke, the distance is one hundred times smaller. The scale could be larger if there existed substantial unobserved constituents, comparable in abundance to the H_2O and OH, but the evidence for this is judged unconvincing. A comet space-probe should aim at investigating plasma properties in the neighborhood of the shock, which are expected to be not unlike properties ahead of Mars. Ionization of the atmosphere provides a suprathermal ion component and there is partial thermalization with some heating even ahead of the shock. (auth)

16584 LINE PROFILES AND TURBULENCE GENERATED BY ACOUSTIC WAVES IN THE SOLAR CHROMOSPHERE. II. Contours of the Ca II and Mg II K Lines. Shine, R. A.; Oster, L. (Univ. of Colorado, Boulder). Astron. Astrophys.; 29: No. 1, 7-12(Nov 1973).

Making use of the time-averaged absorption profiles derived by Oster and Ulmschneider, non-LTE line formation in the context of a two-level atom is investigated for an isothermal atmosphere and for the Ca II and Mg II K lines in the solar chromosphere as represented by the Harvard-Smithsonian Reference Atmosphere. Source functions and emergent line profiles are computed for a variety of assumptions concerning the acoustically broadened profiles and the solar velocity fields. (auth)

16585 LINE PROFILES AND TURBULENCE GENERATED BY ACOUSTIC WAVES IN THE SOLAR CHROMOSPHERE. I. Absorption Profiles and Height Variation of Velocity Amplitudes. Oster, L. (Univ. of Colorado, Boulder); Ulmschneider, P. Astron. Astrophys.; 29: No. 1, 1-6(Nov 1973).

Line profiles produced by Doppler effects due to acoustic waves with velocity profiles ranging from purely sinusoidal to sawtooth-type shock waves are computed in the temperature range typical for the solar chromosphere. The results can be used as local absorption profiles in the computation of the profiles of emerging chromospheric lines. The height variation of velocity profiles and amplitudes is deduced from previous model calculations by Ulmschneider. (auth)

16586 INFLUENCE OF THE CHOICE OF THE SUNSPOT MODEL ON THE DERIVATION OF THE TURBULENT VELOCITY. Baranovskii, E. A.; Stepanyan, N. N. Izv. Krym. Astrofiz. Observ.; 46: 106-114(1972). (In Russian).

The turbulent velocities were determined for a set of the sunspot models. Two methods were used for the derivation of the turbulent velocities. The first was based on the study of the equivalent widths W of the medium strong and strong lines, the second—on the dependence W (Δr_0), where Δr_0 is the depth of the line in its center. The temperature and electron pressure distribution necessary for the calculations were derived from the measurement of the continuous spectrum intensity and the equivalent widths of the weak lines (in the umbra). The existence of the additional absorption in the continuum was suggested in order to bring the theory to better correspondence with the observations. The calculations were made for seven models. The models differed by the character of the dependence $\eta(\tau)$. Here $\eta = \sigma/k$, σ, k—the absorption coefficients in the line and continuum respectively. A rather strong dependence of the derived value of the turbulent velocity on the model properties was obtained. For one of the models the values of the turbulent velocities found by the first and by the second methods were nearly equal. For this model it was found $V_t = 3.1$ km/sec (without any correction for the magnetic intensification) and $V_t = 2.4$ km/sec (after correction for the influence of the magnetic field). (auth)

16587 OBSERVED FACULA LINE PROFILES AND CONTRASTS, COMPARISON WITH MODELS. Stellmacher, G. (Institut d'Astrophysique, Paris); Wiehr, E. Astron. Astrophys.; 29: No. 1, 13-16(Nov 1973).

Profiles of magnetically insensitive lines are measured together with contrasts in real continuum windows for solar facula regions at different positions on the disc with a spatial resolution of about 3''. The contrast measurements confirm earlier observations; the line profiles show the "rest-intensity effect" to decrease towards the limb. Calculations with a number of reasonable facula models indicate that a homogeneous LTE model fails to represent simultaneously the observed contrasts and line profiles, without further assumptions. (auth)

16588 ELECTRON COLLISIONAL EXCITATION OF C^{+2}. Flower, D. R.; Launay, J. M. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 29: No. 2, 321-326(Dec 1973).

The distorted wave and close coupling approximations were used to determine cross sections for electron collisional excitation of C^{+2} from its $2s^2\ ^1S$ ground state. The validity of the approximations is discussed and the results obtained are compared. Good agreement was obtained for the strong transitions. The accuracy of the results was determined by the precision of the bound state wave functions and was estimated to be about 25%. The collisional excitation rates, required in the interpretation of astronomical and laboratory spectra, are presented in convenient numerical form. The astrophysical implications of the results are briefly considered. (auth)

16589 SOLAR CORONA. Passachoff, J. M. Sci. Amer.; 229: No. 4, 69-79(Oct 1973).

Observations from space, rockets, during eclipses, and with coronagraphs are discussed in detail. (WDM)

16590 MAGNETIC DEPOLARIZATION OF FLUORESCENCE LIGHT FOLLOWING EXCITATION OF MG I-ATOMS BY ELECTRON IMPACT. Hentschel, W. R.; Goebel, L. H.; von Oppen, G. (Technische Univ., Berlin). Astron. Astrophys.; 29: No. 3, 415-418(Dec 1973). (In German).

The magnetic depolarization of Mg I-fluorescence light corresponding to the transitions $3s\,nd\ ^1D_2 - 3s3p\ ^1P_1$ (n = 4 to 9) was investigated using electron impact excitation (20 to 60 eV). The half widths of the depolarization signals are related to lifetimes of excited Mg I-levels. Larger half widths were observed if the electron energy was increased. In regard to this dependence the influence of cascading processes on the shape of the depolarization signals is discussed. Upper limits of the lifetimes of the $n\ ^1D_2$-levels were deduced from the measured half widths. The deficiencies resulting from cascading processes can be discarded if in addition to the magnetic field an electric field is applied. A convenient experimental technique is proposed. (auth)

16591 SOLAR ABUNDANCES OF LIGHT NUCLEI AND MIXING OF THE SUN. Bochsler, P. (Univ., Bern); Geiss, J. Solar Phys.; 32: No. 1, 3-11(Sep 1973).

Radial profiles of the light nuclei ($A \leq 15$) were calculated in the nonmixing Sun, taking into account the changes of solar structure with time. The results are discussed in relation to models of solar mixing and compared with abundance determinations at the solar surface or in the solar wind. B cannot be depleted in the outer convective zone without producing a large increase in the $^3He/^4He$ ratio. A decrease in $^3He/^4He$ would be accompanied

by changes in $^{13}C/^{12}C$ and $^{15}N/^{14}N$ of a magnitude which is not observed. It is shown that boron could be depleted in the pre-main sequence period of the Sun, if mixing was on a time-scale of 10^6 yr. The simultaneous small increase in $^3He/^4He$ does not contradict observation. However, Be would be depleted more strongly than B. A $^3He/^4He$ decrease is always accompanied by large changes in $^{15}N/^{14}N$ and $^{13}C/^{12}C$. Since such changes are not observed, it is concluded that the $^3He/^4He$ ratio in the outer convective zone is a reliable upper limit for $(^3He + D)/^4He$ in the solar nebula. Thus the D/H ratio in the protosolar material was much lower than it is in sea water or in carbonaceous chondrites. (auth)

16592 ONE- AND MULTI-COMPONENT MODELS OF THE UPPER PHOTOSPHERE BASED ON MOLECULAR SPECTRA. I. The Violet System of CN (0,0). Mount, G. H.; Linsky, J. L.; Shine, R. A. (Joint Inst. for Lab. Astrophysics, Boulder, CO). Solar Phys.; 32: No. 1, 13-30(Sep 1973).

Spectroheliograms taken in the CN(0,0) violet band near λ3883 Å show very small scale network and cell structures with high contrast. The bandhead itself, which is a broad feature due to overlap of several CN lines, allows the diagnostic simplicity of a continuum since motions, magnetic fields, and broadening mechanisms are unimportant. Spectroheliograms were obtained in the bandhead and center-to-limb photoelectric spectra of CN(0,0) at Kitt Peak National Observatory. From the photoelectric spectra and a detailed analysis of the formation of the CN(0,0) spectrum a best-fit one-component upper photospheric model differing from that of the HSRA was derived and a change in solar carbon abundance from the HSRA value of log A_c = 8.55 to log A_c = 8.25 is recommended. From the calibrated spectroheliograms a multi-component model is considered to account for the observed fine structure intensity variations. (auth)

16593 WHAT IS THE HORIZONTAL SCALE OF THE 5-MIN OSCILLATIONS? Wolff, C. L. (Goddard Space Flight Center, Greenbelt, MD). Solar Phys.; 32: No. 1, 31-39(Sep 1973).

If wrong, all the early reports of a small horizontal scale (≈ 2000 km) for the 5-min-oscillations may be due to unfortunate similarities between the velocity and overturning time of the solar granule convection and the corresponding velocity and period typical of the oscillations. A large horizontal scale (≈ 30,000 km) for the oscillations seems consistent with the old data and almost required by more recent measurements. The large scales recently measured would imply that a sizeable fraction of the solar volume is involved in the oscillation and would cast some doubt on all the old theories of the 5-min-oscillations which were based on plane parallel atmospheres. (auth)

16594 MAGNETIC-FIELD STRUCTURE OF THE PHOTOSPHERIC NETWORK. Stenflo, J. O. (Lund Observatory, Sweden). Solar Phys.; 32: No. 1, 41-63(Sep 1973).

A method is developed to determine the physical parameters of the spatially unresolved photospheric network. The apparent magnetic fluxes are recorded simultaneously in the two Fe I lines 5250 and 5247 Å, which belong to the same multiplet and have practically the same oscillator strength and excitation potential of the lower level, but differ in the effective Landé factor. By analyzing magnetograph recordings in this pair of lines together with simultaneous recordings in the two Fe I lines 5250 and 5233 Å, it is possible to separate the effects on the line profiles due to Zeeman splitting and temperature enhancement in the network. From an analysis of the observations the following properties of the photospheric network are obtained: Field strengths of about 2000 G are present in the network in quiet regions. The characteristic size of the magnetic-field structures in the network appears to be in the range 100 to 300 km. The 5250 Å line is weakened by roughly 50% in the network. If the line had been nonmagnetic, the weakening would have been about 20%. The rest of the weakening is caused by the strong Zeeman splitting. The downward velocity at the supergranular cell boundaries is estimated to be of the order of 0.5 km s^{-1}. (auth)

16595 CORRECTION OF SUNSPOT INTENSITIES FOR SCATTERED LIGHT. Mullan, D. J. (Franklin Inst., Swarthmore, PA). Solar Phys.; 32: No. 1, 65-75(Sep 1973).

Correction of sunspot intensities for scattered light usually involves fitting theoretical curves to observed aureoles (Zwaan, 1965; Staveland, 1970, 1972). In this paper the inaccuracies in the determination of scattered light by this method are examined. Earlier analyses are extended to examine uncertainties due to the choice of the expression for limb darkening, including terms up to $\sin^{12}\theta$. For the spread function Lorentzians and Gaussians for which analytic expressions for the aureole can be written down are considered. Lorentzians lead to divergence and normalization difficulties, and should not be used in scattered light determinations. Gaussian functions are more suitable. (auth)

16596 RADIO RADIUS OF THE SUN AT MILLIMETER AND CENTIMETER WAVELENGTHS. Swanson, P. N. (Pennsylvania State Univ., University Park). Solar Phys.; 32: No. 1, 77-80 (Sep 1973).

The radio radius of the Sun is determined from an analysis of the radio contact times of the March 7, 1970 and July 10, 1972 solar eclipses from λ = 3 mm to λ = 31 cm. Agreement with other eclipse measurements is good. A best fit curve through the several points gives the radio radius to within approximately ± 0.01 of the photospheric radius below λ ≈ 5 cm. (auth)

16597 IDENTIFICATION AND ANALYSIS OF STRUCTURES IN THE CORONA FROM X-RAY PHOTOGRAPHY. Vaiana, G. S.; Krieger, A. S.; Timothy, A. F. (American Science and Engineering, Cambridge, MA). Solar Phys.; 32: No. 1, 81-116(Sep 1973).

The results of a program of rocket observations of the solar corona with grazing incidence x-ray telescopes are summarized. A series of five flights of a Kanigen-surfaced telescope with a few arc seconds resolution, together with the first flight of a newer telescope resulted in the identification of six classes of coronal structures observable in the x-ray photographs. These are: active regions, active region interconnections, large loop structures associated with unipolar magnetic regions, coronal holes, coronal bright points, and the structures surrounding filament cavities. Two solar flares were observed. The methods involved in deriving coronal temperature and density information from x-ray photographs are described and the analysis of a bright active region (McMath plage 11035) observed at the west limb on November 24, 1970 is presented as an example of these techniques. (auth)

16598 OSCILLATOR STRENGTHS FOR 2pnd−2pn'f TRANSITIONS OF CI AND IDENTIFICATIONS IN THE INFRARED SOLAR PHOTOSPHERIC SPECTRUM $1 \leq \lambda \leq 3\mu$. Biemont, E. (Univ., Liege). Solar Phys.; 32: No. 1, 117-129(Sep 1973).

Absolute transition probabilities were calculated for $2p(^3P)nd - 2p(^3P)n'f$ transitions of C I ($1 \leq \lambda \leq 3\mu$). Pair coupling expressions for line strengths were used and the radial wavefunctions were obtained through the use of the Coulomb approximation. A description of the occurrence of these lines in the solar photospheric spectrum is presented and 47 new identifications are proposed. (auth)

16599 DENSITY GRADIENT AND TEMPERATURE OF LOWER CORONA. Leroy, J. L. (Observatoires du Pic du Midi, Toulouse); Poulain, P.; Fort, B. Solar Phys.; 32: No. 1, 131-138 (Sep 1973).

The observations performed at the Pic du Midi Observatory with a K-coronameter at different altitudes above the solar limb allow a computation of the vertical density gradient of the corona, therefore giving the value of the hydrostatic temperature T_h computed under the assumption of hydrostatic equilibrium in the lower corona. T_h is compared with the ratio $r = I_{5303}/I_{6374}$ of the intensities of the green and the red coronal lines observed at the same position angle and on the same day: r is expected to yield the proportion of cold regions and hot regions along the line of sight under study. As a matter of fact no relation appears between individual values of T_h and r nor between averaged values of T_h and r. In a second step the λ 5303 Å emission which should be observed is computed, for selected position angles where λ 6374 Å emissions are faint, making use of the electron density values which can be deduced from the K corona observations. The ratio $Q = (I_{5303})$ obs/(I_{5303}) calc of observed to computed λ 5303 Å intensities should depend upon the corona temperature according to the ionization theory. It is concluded that large deviations to hydrostatic equilibrium probably occur in the corona but it is still possible that the presence of arch structures in the lower corona makes it unrealistic to interpret a ratio of intensities integrated along different lines of sight in terms of a regular density gradient, although this procedure has been universally used up to now. (auth)

16600 DYNAMICS OF SOLAR SURGES. Roy, J. R. (Univ. of Western Ontario, London). Solar Phys.; 32: No. 1, 139-151(Sep 1973).

Curves of velocity as a function of height were determined from time sequences of on- and off-band Hα filtergrams of four surges. The surges behaved as predicted by the melon-seed mechanism. However, in the outward-moving material the deceleration taking place after the maximum velocity had been reached, was stronger than if gravity alone was acting in three of four cases; during the return phase, the acceleration toward the solar surface was less than free-fall in two of three cases. The braking force, opposing the motion, was proportional to the velocity of the surge material. Non-force-free effects in the magnetic field supporting the surge provided a reasonable explanation for the braking. (auth)

16601 NONLINEAR ACCELERATION OF A MAGNETIC DISTURBANCE IN THE SOLAR CORONA. Altschuler, M. D. (National Center for Atmospheric Research, Boulder, CO); Smith,

D. F.; Swartztrauber, P. N.; Priest, E. R. Solar Phys.; 32: No. 1, 153-171(Sep 1973).

The simple form of Ohm's law (SI units) $J = \sigma(E + v \times B)$ is valid for high density magnetofluids (where the mean free path for collisions is less than the Larmor radius) but is not strictly valid for the tenuous solar corona. The nonlinear evolution of a magnetic disturbance was examined using a more general form of Ohm's law which includes the Hall term. The Hall term dominates MHD development in the corona when the product of the magnetic scale length and the square root of the density is small enough; in particular when (1) the electron density is less than about $10^{13} m^{-3}$ and (2) the scale length is less than a few hundred meters. For these parameters, a magnetic disturbance may carry electrons at a drift speed in excess of the Alfvén speed. It is believed that this nonlinear phenomenon may be important for the impulsive acceleration of charged particles in the solar corona. (auth)

16602 FLARES OF AUGUST 1972. Zirin, H.; Tanaka, K. (Hale Observatories, Pasadena, CA). Solar Phys.; 32: No. 1, 173-207(Sep 1973).

The analysis of observations of the August flares at Big Bear and Tel Aviv is presented, involving monochromatic movies, magnetograms, and spectra. In each flare the observations fit a model of particle acceleration in the chromosphere with emission produced by impact and by heating by the energetic electrons and protons. The region showed inverted polarity and high gradients from birth, and flares appear due to strong magnetic shears and gradients across the neutral line produced by sunspot motions. Post flare loops show a strong change from sheared, force-free fields parallel to potential-field-like loops, perpendicular to the neutral line above the surface. Fast (5 s duration) small (1'') flashes in λ3835 at the footpoints of flux loops in the August 2 impulsive flare at 18:38 UT were detected, which may be explained by dumping of >50 keV electrons accelerated in individual flux loops. The flashes showed excellent time and intensity agreement with >45 keV X-rays. In the less impulsive 20:00 UT flare a less impulsive wave of emission in λ3835 moved with the separating footpoints. The thick target model of x-ray production gives a consistent model for x-ray, λ3835, and microwave emission in the 18:38 UT event. Spectra of the August 7 flare showed emission 12 Å FWHM in flare kernels, but only 1 to 2 Å wide in the rest of the flare. The kernels thus produced most of the Hα emission. The total emission in Hα in the August 4 and August 7 flares was about 2×10^{30} erg. It is believed that this dependable value is more accurate than previous larger estimates for great flares. The time dependence of total Hα emission agrees with radio and x-ray data much better than area measurements which depend on the weaker halo. Absorption line spectra showed a large (6 km/s^{-1}) photospheric velocity discontinuity across the neutral line, corresponding to sheared flow across that line. (auth)

16603 Kα LINE EMISSION DURING SOLAR X-RAY BURSTS. Phillips, K. J. H.; Neupert, W. M. (Goddard Space Flight Center, Greenbelt, MD). Solar Phys.; 32: No. 1, 209-225(Sep 1973).

Kα x-ray line emission from S, Ar, Ca, and Fe is calculated for conditions likely to exist in solar flares. Both the nonthermal and thermal phases of flares as indicated by x-ray observations are considered. Impulsive nonthermal events seen at the onset of a flare at photon energies >20 keV generally give rise to small Kα line fluxes (<250 photons cm^{-2} s^{-1}) on the basis of data presented by Kane and Anderson. The amount of S Kα radiation in particular depends sensitively on the lower-energy bound of the nonthermal electron distribution giving rise to the impulsive burst, offering a possible means of determining this. Thermal Kα emission is significant for only Fe ions. For S, Ar, and Ca, the temperatures required for a sizeable number of electrons with energies greater than the K-ionization potential will also strip these elements to ionization stages too high for Kα transitions to be possible. Comparison of thermal Kα emission from iron during an intense solar flare leads to a very high emission measure on the basis of these calculations, but such a value seems to be compatible with an analysis of the 1 to 3 Å continuum during the same event. (auth)

16604 TEMPORAL FINE STRUCTURE OF X RAYS FROM TRAPPED ELECTRONS IN SOLAR FLARES. Brown, J. C. (Univ. of Glasgow). Solar Phys.; 32: No. 1, 227-229(Sep 1973).

It is shown how variations in the trap could explain the x-ray observations but that modification of the basic trapping model demands reconsideration of the overall energy dissipation mechanisms involved. (WDM)

16605 TWO TYPES OF EXTREMELY SHORT LASTING DECIMETRIC BURSTS AND THEIR POSSIBLE RELATION TO PROCESSES IN SOLAR MAGNETIC TRAPS. Elgaroy, O.; Sveen, O. P. (Univ. of Oslo). Solar Phys.; 32: No. 1, 231-240(Sep 1973).

High-resolution spectral observations between 500 and 550 MHz on October 25, 1972 revealed an emission event of special interest. The main feature was bursts with a single frequency duration of about 0.09 s and with a bandwidth of the same order of magnitude as the band covered by the spectrograph. The bursts occurred in "showers" which lasted for one or two minutes and which were separated by quiet intervals of roughly the same length. Frequently the activity assumed a periodic nature. Periods between 0.1 s and 0.3 s were found. The most remarkable feature of the records was a very large number of bursts with the same duration as the wide band bursts, but showing a bandwidth of a mere 1 to 2 MHz. The wide band bursts may be plasma waves excited by proton streams trapped in coronal magnetic fields and the narrow band bursts may possibly be explained as perpendicular electrostatic electron cyclotron waves. (auth)

16606 SPATIAL DISPERSION OF FARADAY ROTATION AND ITS CONNECTION WITH MODE COUPLING. Maetzler, C. (Univ., Bern). Solar Phys.; 32: No. 1, 241-255(Sep 1973).

It is shown that the lack of linear polarization in the microwave radiation of solar bursts (reported in an earlier paper) may be explained by spatial dispersion of Faraday rotation. The maximum source diameter s without noticeable destruction of linear polarization is determined by the electron density and the magnetic-field strength in the volume, where the linear polarization is generated. In the case where linear polarization is produced by the radiation source, s is smaller than only 20 km. In the other case where linear polarization is produced by mode coupling in a quasi-transverse magnetic field in the corona, the s-values are found to range from 10 to 6000 km, which is still much smaller than the generally adopted sizes of microwave burst sources. The second case is investigated for several models of magnetic fields. (auth)

16607 NUMERICAL STUDIES OF AZIMUTHAL MODULATIONS OF THE SOLAR WIND WITH MAGNETIC FIELDS. Nakagawa, Y. (High Altitude Observatory, Boulder, CO); Welick, R. E. Solar Phys.; 32: No. 1, 257-270(Sep 1973).

The evolution of azimuthal modulation of the solar wind is examined by numerical integration of the basic equations governing supersonic, super-Alfvénic, polytropic one fluid flow in the equatorial plane of the Sun with radial as well as azimuthal magnetic fields. The computations are started by introducing various sets of finite amplitude perturbations stationary with respect to the Sun. It is shown that for a properly chosen set of simultaneous perturbations of the radial velocity and temperature, quantitative agreement with the averaged observational results at 1 AU can be obtained, including the advance of the density modulation with respect to those of velocity and temperature. It is further shown that modulations at 1 AU depend on the relative azimuthal positions between the Sun and the Earth. (auth)

16608 SPECTRUM OF A LARGE UMBRA. I. Magnetic Features of the Dark Core and a Region with Fine Structures. Buurman, J. (Astronomical Inst., Utrecht). Astron. Astrophys.; 29: No. 3, 329-334(Dec 1973).

Spectrograms from the dark core and from a region with fine structure of a large umbra (λλ 5000 to 6900 Å) near the center of the disc were obtained in both directions of circular polarization simultaneously. Magnetic field strengths derived for the dark core from various lines indicated no fluctuations in the field strength correlated with temperature fluctuations. There was no indication for the presence of invisible hot umbral dots with strong magnetic fields either. The magnetic field in the dark core was nearly longitudinal, with $H = 3120 \pm 40$ G. The magnetic field strength in the region with some visible fine structure amounted to 2850 ± 100 G; on the average the magnetic field was slightly more inclined with respect to the line of sight than in the dark core. No abnormalities were found in the π-components, which was in agreement with Wittmann (1971), who found that abnormal π-components may only occur if the field is sufficiently inclined with respect to the line of sight. As an example of the use of sunspot spectra in the two directions of circular polarizations, seven Ba I lines were identified in the umbral spectrum. (auth)

16609 EXPERIMENTAL OSCILLATOR STRENGTHS OF TII LINES. Klemt, M. (Univ., Kiel). Astron. Astrophys.; 29: No. 3, 419-423(Dec 1973). (In German).

Relative oscillator strengths of 139 TiII lines were determined from emission measurements of a three chamber electric arc burning in an argon atmosphere. Introducing a small admixture of titanium chloride into the center of the arc, spectra of titanium could be observed end-on with no self-absorption and no self-reversal of the measured lines. The relative oscillator strengths were obtained from the TiI line intensities and the measured arc temperature. Using absolute oscillator strengths of three resonance lines which had been measured by Reinke (1967), and several life time measurements from Hese (1970), Witt et al. (1971), and Andersen and Sørensen (1972), the relative oscillator strengths were converted to an absolute scale. The accuracy of these absolute values is in the range of 20% to 40%. (auth)

16610 INTERPLANETARY SHOCK WAVE GENERATION. Dorman, L. I. (IZMIRAN, Moscow). Comments Astrophys. Space Phys.; 5: No. 4, 87-91(1973).

The shock waves caused by chromospheric flares are usually believed to generate in the solar atmosphere. In an attempt to answer this question, the data on the increase effect in primary cosmic-ray intensity before the start of a magnetic storm are examined. (WDM)

16611 SOLAR NEUTRAL IRON SPECTRUM. II. Profile Synthesis of Representatives Fe I Fraunhofer Lines. Lites, B. W. (High Altitude Observatory, Boulder, CO). Solar Phys.; 32: No. 2, 238-306(Oct 1973).

The profiles of eighteen neutral iron lines of varying strengths were synthesized from disk center to the limb using source functions from detailed statistical equilibrium calculations. Emphasis was placed upon the analysis of the strong Fe I lines between 3500 Å and 4500 Å which are formed at and below the region of the initial temperature rise in the chromosphere. The major results were as follows: (1) An iron abundance of 1.5×10^{-5} relative to hydrogen was found (7.2 on a logarithmic scale with hydrogen equal to 12) that is independent of the assumed microturbulence model since it is based upon the far wing profiles of the strong lines. The far wings are formed in the photosphere where both the ionization and excitation equilibria are in detailed balance, so this abundance is directly comparable to other LTE abundances. (2) The strong line cores indicate that the chromospheric electron densities in the region of the initial temperature rise are similar to those derived by Henze (1969) from eclipse observations; i.e., higher than the HSRA model (Gingerich et al., 1971) by factors of two to five. An anisotropic (angle-dependent) microturbulent velocity model, and a mean macroturbulent velocity that aids in fitting the line cores are presented. The formation of the two FE I lines λ5232.95 and λ5250.21 is also discussed. (auth)

16612 STRUCTURE OF THE SOLAR PHOTOSPHERE. Krat, V. A. (Pulkovo Observatory, Leningrad). Solar Phys.; 32: No. 2, 307-310(Oct 1973).

Based on results from the Soviet Solar Stratospheric Observatory, a model for the photosphere is presented. (WDM)

16613 LOCATION OF EXPLODING GRANULES. Allen, M. S.; Musman, S. (Air Force Cambridge Research Labs., Sunspot, NM). Solar Phys.; 32: No. 2, 311-314(Oct 1973).

The occurrence of narrow blue spikes in high resolution spectra of Fe I λ5269 taken at the Sacramento Peak Observatory by Hyder (1970) led him to suggest that these features might be associated with the upward velocities in exploding granules and lead to the formation of spicules. As is known from Beckers and Morrison (1970) granules exhibit a toroidal flow pattern which is upward in the center. This kind of flow was used by Musman (1972) to explain exploding granules. An earlier examination of granulation photographs gave some evidence that exploding granules did not occur at random locations. The location of exploding granules is compared with the location of the chromospheric network. To accomplish this the locations of exploding granules were compared with the location of the overlying chromospheric network where concentrations of magnetic field and spicules appear. K2 violet filtergrams were used as a convenient locator of the chromospheric network. (WDM)

16614 SOLAR POLAR SPIN-DOWN. Schatten, K. H. (Victoria Univ., Wellington, New Zealand). Solar Phys.; 32: No. 2, 315-336(Oct 1973).

An explanation for the solar differential rotation is proposed that makes use of angular momentum transfer in the solar wind and corona. Evidence suggests that for most of the solar cycle, the solar wind is connected by magnetic field lines to high heliographic latitudes on the Sun. Thus the angular momentum lost to the solar wind would present a preferential "drag" to the photospheric material at high heliographic latitudes. It is shown that this drag is sufficient to offset the restoring forces of the Sun's subsurface magnetic field. In fact, the subsurface magnetic field and differential rotation are thought to grow until the stresses are sufficient to balance the torque induced by the solar wind. The present level of differential rotation and solar activity may be maintained by an intricate feedback mechanism involving the whole solar activity cycle. A power calculation based upon this model suggests the Sun's core rotates with a period of between 0.5 and 5 days. Furthermore, this view requires a major change in present theory of solar magnetic field generation. (auth)

16615 SOLAR SPICULES OBSERVED THROUGH A K-FILTER. Banos, G. (National Observatory of Athens). Solar Phys.; 32: No. 2, 337-344(Oct 1973).

Some properties of the solar spicules as observed outside the limb through a Halle K-filter at the center of the line were investigated. The observations were made at the Pic-du-Midi Observatory. The results were as follows: (a) The chromosphere at the limb appears more diffuse in the K line than in the Hα line, the spicules being not well resolved. (b) The ratio of spicule intensity to the background intensity increases with height, as in the case of Hα spicules, but it is, in every height, smaller than that in Hα. (c) The spicule mean width is measured photometrically and found equal to 1900 km. (d) The lifetime is found to be 4.5 min. (e) The mean chromospheric height is estimated to be 6,000 km. (auth)

16616 SPECTROSCOPIC STUDY OF SOLAR SPICULES IN Hα, Hβ, AND K. Alissandrakis, C. E. (Univ. of Maryland, College Park). Solar Phys.; 32: No. 2, 345-359(Oct 1973).

Simultaneous spectra of spicules in Hα, Hβ, and the Ca II K were analyzed. These spectra were obtained with the échelle spectrograph of Sacramento Peak Observatory and had a resolution of 1.5 s of arc. Data included absolute intensities, velocities, linewidths, and the optical depth at the center of Hα. Electron densities ranged between 6×10^{10} cm^{-3} and 1.2×10^{11} cm^{-3}, while the range of the electron temperature was between 12,000K and 15,000K at a height of 5400 km above the limb. The analysis of the variation of the line of sight velocity across spicules showed that their rotation was very small. There was very good correlation in the structure of all three lines. (auth)

16617 CALCULATION OF THE SOLAR CHROMOSPHERIC Lα PROFILE ALLOWING FOR PARTIAL REDISTRIBUTION EFFECTS. Milkey, R. W. (Kitt Peak National Observatory, Tucson, AZ); Mihalas, D. Solar Phys.; 32: No. 2, 361-363(Oct 1973).

Recent work by Vernazza (1972) and by Vernazza et al (1973) showed that the assumption of complete redistribution of the emitted photons over the entire line profile fails badly to match observation. With complete redistribution, the predicted line wing is too bright by a factor of 5 or 6. Methods for treating the partial redistribution problem have now been developed (Milkey and Mihalas, 1973), and are applied to a schematic Lα calculation to assess whether the effects of partial redistribution explains the discrepancy. (WDM)

16618 RELATIONSHIP BETWEEN SOME PHOTOSPHERIC MOTIONS AND THE EVOLUTION OF ACTIVE CENTERS. Martres, M. J.; Soru-Escaut, I.; Rayrole, J. (Meudon Observatory, France). Solar Phys.; 32: No. 2, 365-378(Oct 1973).

A comparative study of magnetic fields and photospheric velocities has shown that the appearance of certain velocity configurations can be associated with subsequent changes in the observed local magnetic field. A descriptive empirical relationship seems to be applicable both to spots and spotless regions. (auth)

16619 VIDEOMAGNETOGRAPH STUDIES OF SOLAR MAGNETIC FIELDS. II. Field Changes in an Active Region. Schoolman, S. A. (California Inst. of Tech., Pasadena). Solar Phys.; 32: No. 2, 379-388(Oct 1973).

Using the Caltech videomagnetograph, a 6½ h movie of the magnetic fields in a young active region was obtained. The major contribution to the short term magnetic evolution of the region was provided by many discrete magnetic points which move in apparently random directions with typical velocities of 0.4 to 1.0 km s^{-1}. The majority of these features appear to be footpoints of new EFR's, which emerge at an observed rate of one to two per hour. The pattern of the motions suggests that the magnetic evolution of a growing region cannot be principally due to photospheric convective cells. (auth)

16620 EPHEMERAL ACTIVE REGIONS. Harvey, K. L.; Martin, S. F. (Lockheed Solar Observatory, Burbank, CA). Solar Phys.; 32: No. 2, 389-402(Oct 1973).

Ephemeral active regions attain maximum development within 1 day or less of their initial appearance and are typically observed for 1 to 2 days. They appear mostly as small bipolar regions having a typical dimension of about 30,000 km and a maximum total flux of the order of 10^{20} Mx. The ephemeral regions generally do not produce sunspots and flares, though they are identified in Hα as small active centers. Observations indicate that the ephemeral regions are frequently generated both near large active centers and in extensive quiet areas of the Sun. The location of emerging ephemeral regions does not appear to be associated with the distribution of the existing network fields. As many as 100 ephemeral regions may form per day. On the average, as much flux may erupt in the form of small ephemeral regions as erupts in larger active centers. The latitude distribution of ephemeral regions appears to be much wider than that of sunspots and major active centers. Their frequency of occurrence does not appear to follow the sunspot cycle. (auth)

16621 INTERPRETATION OF SOME PECULIARITIES OBSERVED IN ZEEMAN-SPLIT LINE CONTOURS IN SUNSPOTS. Staude, J. (Zentralinstitut fuer Sola-Terrestrische Physik, Potsdam, Ger.). Solar Phys.; 32: No. 2, 403-408(Oct 1973).

Strong line wings and the V-reversal in umbral contours of Fe I 6302.5 Å and similar lines have been explained earlier by inhomogeneous magnetic models. It is shown that both effects may also be explained assuming a homogeneous magnetic field and homogeneous umbral model atmospheres. A discussion of the difficulties arising in LTE calculations of Fe I 5250.2 Å-contours by means of umbral models recently derived suggests that the high layers of these models are strongly influenced by non-LTE, a temperature minimum occurring perhaps at larger depths than in the undisturbed photosphere. (auth)

16622 PHOTOMETRIC STUDY OF FINE STRUCTURE OF A SUNSPOT PENUMBRA. Muller, R. (Observatoire du Pic du Midi, Bagneres de Bigorre, France). Solar Phys.; 32: No. 2, 409-420(Oct 1973). (In French).

The microphotometric analysis of the fine structure of a sunspot penumbra, photographed in white light with the 38 cm refractor of the Pic du Midi Observatory with a resolution very close to 0.3", allows to give from it, at λ5280, the following picture: the penumbra appears to consist of bright grains, lined up in the form of filaments, with an average brightness I_b/I = 0.95 of average width 0.36" (270 km) and which cover 43% of its surface, showing up a dark background of brightness I_b/I = 0.6 nearly uniform. (auth)

16623 OSCILLATORY VELOCITY FIELD OBSERVED IN A UNIPOLAR SUNSPOT REGION. Rice, J. B. (Univ. of Alberta, Edmonton); Gaizauskas, V. Solar Phys.; 32: No. 2, 421-433(Oct 1973).

The velocity field was mapped for 42 min in an area 80" by 85" containing a unipolar sunspot. Apparent shifts of Fe I λ5233 were measured photoelectrically using a rectangular scanning aperture 1.6" × 4.0". The sunspot did not exert a marked influence on the generally random pattern of oscillations at a period of 300 s. Discrete periods of oscillation both longer and shorter than 300 s were excited within the enhanced magnetic field boundaries of this spot. Umbral oscillations at periods near 180 s were detected in agreement with independent observations of the same spot during the previous solar rotation. (auth)

16624 COOLING OF A SUNSPOT. III. Recent Observations. Wilson, P. R. (Univ. of Sydney). Solar Phys.; 32: No. 2, 435-439(Oct 1973).

The coordinates of the cooling cycle described in Paper I are re-defined in order to provide an account in which the part played by the cycle in cooling the sunspot is separated from the role of the supergranule cells in transporting energy away from it. More recent observations of velocity fields and magnetic outflow near sunspots are discussed. A model suggested by Harvey and Harvey to explain the observed magnetic flux transported across the moat region is refined and extended using the cooling cycle model. (auth)

16625 COMMENTS ON PAPERS BY P. R. WILSON CONCERNING SUNSPOTS. Mullan, D. J. (Bartol Research Foundation, Swarthmore, PA). Solar Phys.; 32: No. 2, 441-444(Oct 1973).

In a series of papers Wilson (1972a, b, 1973) has proposed a Carnot cycle to explain the cooling of a sunspot. It is the purpose of this note to point out some inconsistencies in these papers. If the cooling cycle envisaged by Wilson operates at all, it falls short of the cooling required in a spot by a factor of at least 100. (auth)

16626 BRIGHTNESS DISTRIBUTION OF THE SUN AT 2.8 cm WAVELENGTH. Fuerst, E. (Max-Planck-Institut fuer Radioastronomie, Bonn); Hachenberg, O.; Zinz, W.; Hirth, W. Solar Phys.; 32: No. 2, 445-458(Oct 1973).

Maps of the Sun at 2.8 cm wavelength, observed with the 100-m telescope in Effelsberg, on October 31, 1972 and February 10, 1973, are discussed. The brightness distribution over the Sun is, with the exception of active regions, approximately constant and nearly sharp-edged. Regions of small enhancements in the radiation can be identified with zones of weak activity in the solar magnetograms. Optical filaments could also be seen in absorption at 2.8 cm wavelength, the optical depth being of the order of 0.2. Several active regions were analyzed with respect to their position relative to their optical counterparts and to their brightness temperature: The latter was found to reach almost 10^6K in one case. No noticeable limb brightening could be observed; if any exists, it should be smaller than 5%. Likewise no noticeable elliptical deformation of the Sun's disk could be found. The geometrical thickness of the coronal layer, contributing to the undisturbed radiation at 2.8 cm was estimated to be a maximum of 4000 km. (auth)

16627 EVIDENCE FOR THIN-TARGET X-RAY EMISSION IN A SMALL SOLAR FLARE ON 26 FEBRUARY 1972. Datlowe, D. W. (Univ. of California, San Diego, La Jolla); Lin, R. P. Solar Phys.; 32: No. 2, 459-468(Oct 1973).

Solar x-ray observations from the UCSD experiment aboard OSO-7 were compared with high-resolution energetic electron observations from the UCAL experiment on IMP-6 for a small solar flare on February 26, 1972. A proportional counter and NaI scintillator covered the x-ray energy range 5 to 300 keV, while a semiconductor detector telescope covered electrons from 18 to ~ 400 keV. A series of four nonthermal x-ray spikes were observed from 1805 to 1814 UT with average spectrum $dJ/d(h\nu) \sim (h\nu)^{-4.0}$ over the 14 to 64 keV range. The energetic electrons were observed at 1 AU beginning 1840 UT with a spectrum $dJ/dE \sim E^{-3.1}$. If the electrons which produce the x-ray emission and those observed at 1 AU are assumed to originate in a common source, then these observations are consistent with thin target x-ray production at the Sun and inconsistent with thick target production. Under a model consistent with the observed soft x-ray emission, quantitative estimates were obtained of the total energy, total number, escape efficiency, and energy lost in collisions for the energetic electrons. (auth)

16628 FURTHER POLARIZATION MEASUREMENTS OF THE SOLAR FLARE X-RAY EMISSION. Tindo, I. P.; Mandel'stam, S. L.; Shuryghin, A. I. (Lebedev Inst. of Physics, Moscow). Solar Phys.; 32: No. 2, 469-475(Oct 1973).

An improved x-ray polarimeter is briefly described and preliminary results of the measurements carried out on the satellite "Intercosmos-7" are presented. One flare with considerable polarization (P ≥ 16%) was observed on August 4, 1972. Two other flares with rather low polarization (P ≈ 4%; P ≥ 2%) were observed on August 7 and 11, 1972. (auth)

16629 POSSIBLE ROLE OF ENERGETIC ELECTRONS IN THE PRODUCTION OF SURGES. Kahler, S. W. (American Science and Engineering, Cambridge, MA). Solar Phys.; 32: No. 2, 477-484(Oct 1973).

Energetic electrons, which play a major role in the explosive phases of flares, are proposed as the energy source for the production of surges. Flare data from a two-year interval are analyzed to show that the probability of having surges associated with flares is greater when there are accompanying decimeter Type III bursts or impulsive 8800 MHz bursts. The model of chromospheric heating by impulsive electrons proposed by Hudson is examined and shown to provide an adequate explanation for the origin of flare surges. The proposed surge model is consistent with the temporal evolution of the flare-surge event and the required surge energy. Surges not accompanied by flares can also probably be explained by the model. (auth)

16630 DAMPED TRAIN OF REGULAR METRE-WAVE PULSES FROM THE SUN. McLean, D. J.; Sheridan, K. V. (CSIRO, Sydney). Solar Phys.; 32: No. 2, 485-489(Oct 1973).

The metre-wave observations of a damped train of regular pulses from the Sun appear much simpler than other similar events previously described. The interpretations so far proposed for such phenomena do not adequately explain the asymmetry observed in this case. (auth)

16631 GYRO-SYNCHROTRON RADIATION FROM MOVING TYPE IV SOURCES IN THE SOLAR CORONA. Dulk, G. A. (CSIRO, Sydney). Solar Phys.; 32: No. 2, 491-503(Oct 1973).

Calculations of the gyro-synchrotron emission are made for conditions which might be expected in moving Type IV sources in the solar corona. Two simple models for an evolving source are treated: a uniform cube and an inhomogeneous sphere. The results suggest that most moving sources have the following features: (1) A rather strong magnetic field, ≈ 10 G, is carried out within the source. This is required to achieve the high degree of circular polarization often observed. (2) Synchrotron self-absorption causes the source to be optically thick at frequencies less than about 100 MHz, thus restricting the bandwidth of the radiation. The self-absorption decreases as the source moves outward and expands. The turnover frequency, which separates the optically thick and thin spectral regimes, moves rapidly to lower frequencies, accompanied by a change from low to high circular polarization. In the case of an inhomogeneous source, the source appears to be larger at the lower frequencies. (3) Razin–Tsytovich suppression cannot be an important factor in determining the characteristics of most sources. (auth)

16632 SPREAD FUNCTION FOR STRAY LIGHT. Hansen, T. (Univ. of Oslo). Solar Phys.; 32: No. 2, 505-506(Oct 1973).

A simplification is offered for the normalization of the spread function of Zwaan (1965) and Brahde (1972). (WDM)

16633 COMMENTS ON "RADIOCARBON: SHORT-TERM VARIATIONS" BY M. S. BAXTER AND J. G. FARMER. Damon,

P. E.; Long, A.; Wallick, E. I. (Univ. of Arizona, Tucson). Earth Planet. Sci. Lett.; 20: No. 3, 311-314(Nov 1973).

Comments on Baxter and Farmer's (1973) point about the latitudinal and altitudinal variations of carbon-14 level are offered. (WDM)

16634 COMMENTS ON "ON THE MAGNITUDE OF THE 11-YEAR RADIOCARBON CYCLE" BY P. E. DAMON, AUSTIN LONG, AND E. I. WALLICK. Baxter, M. S. (Univ. of Glasgow); Farmer, J. G.; Walton, A. Earth Planet. Sci. Lett.; 20: No. 3, 307-310 (Nov 1973).

Comments are offered under the headings quality of data, general tenor, and theoretical limitations. (WDM)

16635 MAGNITUDE OF THE 11-YEAR RADIOCARBON CYCLE. Damon, P. E.; Long, A.; Wallick, E. I. (Univ. of Arizona, Tucson). Earth Planet. Sci. Lett.; 20: No. 3, 300-306(Nov 1973).

Radiocarbon and stable carbon isotope analyses of annual tree rings for the 15-yr period from A.D. 1940 through 1954 do not confirm the existence of an 11-yr cyclical change in the ^{14}C activity of atmospheric CO_2 having a 30% amplitude (peak to trough). The results are in accord with predictions based upon the relationship between radiocarbon production and solar activity. Specifically, amplitude variation of ~3% was found during the 11-yr solar cycle that reflects the attenuation of the radiocarbon fluctuations by the atmosphere acting as a low-pass filter. The minimum and maximum of the radiocarbon and solar cycles are inversely related with radiocarbon lagging by about 2 years. An increase of about 5% between A.D. 1952 and A.D 1954 is an expected result of nuclear weapon tests. Although the results are in qualitative agreement with theoretical expectation, measurement errors do not allow precise determination of the relatively small amplitude of the atmospheric radiocarbon variation due to the 11-yr solar cycle. (auth)

16636 RADIOCARBON: SHORT-TERM VARIATIONS. Baxter, M. S.; Farmer, J. G. (Univ. of Glasgow). Earth Planet. Sci. Lett.; 20: No. 3, 295-299(Nov 1973).

Analyses of 19th century single tree rings indicate that natural ^{14}C fluctuations of 20% over the 11-yr sunspot cycle have occurred in correlation with solar activity. Consequently, an additional error of at least ±80 years is inevitable in the radiocarbon age determination of dating samples of lifetime one year. (auth)

16637 CONCENTRATIONS OF THE HEAVY METALS IN THE FOUR NEW ANTARCTIC METEORITES YAMATO (a), (b), (c), AND (d) AND IN ORGUEIL, MURRAY, ALLENDE, ABEE, ALLEGAN, MOCS, AND JOHNSTOWN. Hintenberger, H.; Jochum, K. P.; Seufert, M. (Max-Planck-Institut fuer Chemie, Mainz). Earth Planet. Sci. Lett.; 20: No. 3, 391-394(Nov 1973).

In the four meteorites Yamato (a), (b), (c), and (d) recently found in Antarctica, the trace elements W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Th, and U were determined by spark source mass spectrometry. The concentrations of these elements were also measured in the meteorites Orgueil (C1), Murray (C2), Allende (C3), Abee (E4), Allegan (H5), Mocs (L6), and Johnstown (Ah). The trace element concentrations confirm the preliminary classification of the Yamato meteorites already given earlier: Yamato (a) = enstatite chondrite, Yamato (b) = Ca-poor achondrite, Yamato (c) = carbonaceous chondrite of type 3, Yamato (d) = ordinary chondrite. The concentrations of Au and Hg are antipathetically correlated. In the achondrite Yamato (b) the concentrations of the siderophile elements W, Re, Os, Ir, and Pt depend strongly on the boiling points of these metals. (auth)

16638 DIFFUSION OF CO AND CH MOLECULES IN THE SOLAR ATMOSPHERE. Sinha, K.; Pande, M. C. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech.; 24: No. 6, 334-336(1973).

The calculated rates of photodissociation, radiative association, and the diffusion of CH and CO molecules show that the diffusion rates are many orders of magnitude smaller than the photodissociation and radiative association rates, both in the photosphere and spots. Moreover, the diffusion velocities are much smaller than the turbulence velocities in the photosphere and spots. Thus, the diffusion of diatomic molecules (with dissociation energies in the range 3.47 eV to 11.01 eV) is not possible in the solar atmosphere. (auth)

16639 OBSERVATIONS OF MOVING SOLAR PLASMA CLOUDS AT $10R_\odot$. Pinter, S. (Geophysical Inst., Hurbanovo, Czech.). Bull. Astron. Inst. Czech.; 24: No. 6, 337-342(1973).

At the time of the superior conjunction of the space probe Pioneer 6 (Levy et al., 1969; Goldstein, 1969), the Faraday rotation of the polarization and the spectrum of the radio signals from the spacecraft, as well as its broadening as the rays passed close to the Sun were observed. Several transient Faraday rotation phenomena and an enhancement of the spectral broadening were found. Under the assumption that these events were caused by the ejection of concentrated magnetized plasma from the Sun, the relation of these events to flares which occurred in connection with a certain form of ejection of mass, e.g., loops, sprays, surges, eruptive prominences, Type II bursts, and type IV bursts was investigated. The average velocity of the transport of coronal plasma appeared to be 350 km/s. The duration of each phenomena was approximately 2 hours. Moving solar plasma clouds have a typical dimension of 2.5×10^5 km at a heliocentric distance of $10\ R_\odot$. (auth)

16640 OBSERVATIONS OF SOLAR FLARES AT ONDREJOV OBSERVATORY DURING THE YEARS 1971 TO 1972. Hrebik, F.; Sebl, J.; Krivsky, L. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 6, 343-350(1973).

This paper is a continuation of thirteen preceding reports which contained solar flares observed at Ondřejov Observatory from 1948 up to end of 1970 and covers the period of 1971–1972. The data about 184 flares, associated 9400, 808, 536, and 260 MHz events, and 27 KHz SEA observed and recorded during 1971–1972, are summarized. The corresponding curves of the Hα line-width changes are plotted. The net times of observations of the chromosphere made by spectroheliosсope and the net times of measurements of the solar flux at 536 MHz are also given. (auth)

16641 MEASUREMENTS OF THE SOLAR X-RAY FLUX ON BOARD OF THE SATELLITES INTERKOSMOS 1, 4, AND 7. Valnicek, B. (Astronomical Observatory, Ondrejov, Czech.); Farnik, F.; Horn, J.; Letfus, V.; Sudova, J.; Komarek, B.; Engelthaler, P.; Ulrych, J.; Moucka, L.; Fronka, O.; Vasek, T.; Beranek, I.; Plch, J.; Zderadicka, J. Bull. Astron. Inst. Czech.; 24: No. 6, 362-373(1973).

A review is given of the Czechoslovak participation in the Interkosmos space research program in the field of solar x rays. The fundamental characteristics of the x-ray photometers on board the satellites Interkosmos 1, 4, and 7 are given, particularly a review of the detectors, their properties, and method of calibration. Fundamental data on the electronics, on data telemetry and their processing are mentioned, as well as a brief review of the results obtained. A list of references, containing further technical data and the interpretation of the results obtained, is also included. (auth)

16642 SUDDEN CHANGES OF ACTIVITY BEFORE PROTON FLARES. Events of August 1972. Krivskii, L. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 6, 375-377(1973).

The evolution of flare activity was followed by the method of cumulative summations curves according to the observed flares and the outbursts of x-rays (measured on satellites) in the active region during one revolution when there were powerful flares. It was proved again that several tens of hours before the occurrence of flares with the emission of fast protons the activity of the active region in question was rising. (auth)

16643 PARTICLE CONCENTRATION IN THE ASTEROID BELT FROM PIONEER 10. Soberman, R. K.; Neste, S. I.; Lichtenfeld, K. (General Electric Space Science Lab., Philadelphia). Science; 183: No. 4122, 320-321(25 Jan 1974).

The spatial concentration and size distribution for particles measured by the asteroid/meteoroid detector on Pioneer 10 between 2 and 3.5 Au are presented. The size distribution was from about 35 micrometers to 10 centimeters. The exponent of the size dependence varied from approximately −1.7 for the smallest to approximately −3.0 for the largest size measured. (auth)

16644 INVESTIGATION OF SOLAR ACTIVITY AND ITS ASSOCIATION WITH COSMIC RAY VARIATIONS. Razmadze, T. S. pp 95-103 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian)

The solar activity during the IGY and IQSY was studied on the basis of a cyclic law, using characteristic spot areas and relative spot numbers as solar-activity indices. The influence of solar activity on the variation of the intensity of the neutron component of cosmic rays is shown to manifest itself in the form of a superposition of various effects which are associated with the activity of the solar hemispheres and which are shifted in time. (IAA)

16645 SOLAR CONSTANT AND THE ENERGY DISTRIBUTION IN THE SOLAR SPECTRUM. Makarova, E. A.; Kharitonov, A. V. Moscow; Izdatel'stvo Nauka (1972). 288p. (In Russian).

Available data on the solar energy flux and its spectral components are reviewed and critically analyzed. On the basis of extensive measurement data obtained by various methods, it is shown that the most reliable value of the solar constant is 195 cal/sq cm-sec (or 136 mWt/sq cm). Weighted-mean data on the energy distribution in the solar spectrum from 1400 A to 0.3 mm

are presented. Among the topics studied are: the attenuation of radiation in the Earth's atmosphere, instrument problems in absolute spectrophotometry, the influence of limb darkening of the solar disk on the energy distribution in the solar spectrum, and the energy distribution in the spectrum of the solar photosphere. (IAA)

16646 TEMPERATURE IN SOLAR FLARES. Smith, E. P. (Univ. of Maryland, College Park). pp 2359-2368 of Symposium on Temperature. Part 3. Pittsburgh; Instrument Society of America (1972).

From proceedings of the 5th symposium on temperature; Washington, DC (21 Jun 1971).

Analyses of the chromospheric hydrogen and helium spectral lines in flares have been quite fruitful in suggesting electron temperatures by fitting temperature and density models. Studies of these lines in several flares suggest temperatures ranging from 7000 to 40,000 K, even within a given flare. Ionization temperatures as high as 20,000,000 K have been determined by assuming that if lines from a given stage of ionization appear in any strength, then the temperature of the plasma is that corresponding to the temperature necessary to produce that ion. The energy spectra of the thermal portions of hard x-ray (7 to 210 keV) flares can be fit with temperatures comparable to those derived from soft x-rays. Analyses of selected soft x-ray lines lead to values of the electron density several orders of magnitude greater than normal coronal densities. (IAA)

16647 SUN: OBSERVATORIES, SATELLITES, AND AN ECLIPSE. Pasachoff, J. M. Recherche (Paris); 4: 576-579 (Jun 1973). (In French).

The atmosphere is the major obstacle to observation of the solar surface from the ground, but under good conditions, and with new instruments, good results have been obtained. Internal parts of the corona can be observed with coronagraphs, and numerous aspects of the corona can be studied from space. Various solar observatories launched by NASA have carried apparatus which can observe very short wavelengths in the ultraviolet. Procedures for studying the eclipse of June 30, 1973, are discussed. One of these involves use of the Concorde SST, which could observe the eclipse for an hour by fixing along the path of totality. (IAA)

16648 DIFFERENCE BETWEEN EVEN AND ODD 11-YEAR SOLAR ACTIVITY CYCLES. Bonov, A. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 6: 23-29(1973). (In Bulgarian).

A discussion is presented on the inverse relations between the maximum phases and Wolf numbers in 11-year solar activity cycles. Different equations of regression are proposed for even and odd 11-year cycles. The different character of correlation diagrams of the two types of 11-year cycles is also noted. It is suggested that the numerical numbers of 11-year solar activity cycles should be taken into consideration in solar activity forecasting. (IAA)

16649 COMPARISON OF THE SECTORIAL STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD AND THE OCCURRENCE OF SC AND SI EVENTS. Moldovanu, A.; Bradu, E. B. Gerlands Beitr. Geophys.; 82: No. 3, 171-174(1973).

The evolution of the sectorial structure of the interplanetary magnetic field is compared with the occurrence of the SC and SI events for the period of solar rotations No. 1839-1852, near the maximum of the solar cycle No. 20. It is found that most of the collective gr(SC + SI) events are either connected with sector boundaries or recurring. This result makes it possible to conclude that the bulk of gr(SC + SI) events are accounted for by the details of the sectorial and subsectorial structure in the solar wind, corotating with the Sun. (auth)

16650 SPECTRUM OF THE S- AND B-COMPONENTS OF SOLAR RADIO EMISSION AT DM-WAVELENGTHS. Krueger, A. (Heinrich-Hertz-Institut fuer Solar-Terrestrische Physik, Berlin). Bull. Astron. Inst. Czech.; 24: No. 4, 202-207(1973).

The S- and B-components of the solar radio emission have been separated by means of a correlation analysis. Some comparisons with cyclic variations of the soft solar x-ray emission are included. The remarkable spectral maximum of the B-component in the dm-region is interpreted as an effect of an increase of coronal density during the solar cycle, shifting the emission level of medium dm-waves by increasing optical depths from cooler chromospheric into hotter coronal zones. (auth)

16651 PRELIMINARY PHOTOMETRIC STUDY IN THE FAR ULTRAVIOLET OF THE ZODIACAL AND GALACTIC EMISSION. Maucherat, M. H. Marseille; Univ. Marseille (1972). 86p. (In French).

Thesis.

The distribution of the zodiacal light at 90° from the Sun, in several colors in the domain of ultraviolet radiations, is studied. The instrument is to be placed aboard the French D2B satellite, pointed at the Sun. By precession of the orbit of the satellite in the course of a year, the complete ecliptic circle will be made. It is shown to be important to study the distribution of the zodiacal light above the atmosphere, both as concerns knowledge of the interplanetary medium and of the factor of limitation of the contrast in the observation of weak objects. It will be possible to obtain the distribution of the galactic light in the far ultraviolet and the distribution of luminances of the diffusion of the solar light by the interplanetary matter at 90° from the Sun. It is hoped to make an ultraviolet study of certain extragalactic objects, such as the Magellanic Clouds. (IAA)

16652 CHARACTERISTIC FEATURES OF SECULAR AND SUPERSECULAR CYCLES OF SOLAR ACTIVITY. Bonov, A. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 6: 15-22(1973). (In Bulgarian).

Galaxies

Refer also to abstracts 16532 and 16547.

16653 INTENSITY CALIBRATION OF THE INTERSTELLAR CARBON MONOXIDE LINE AT λ2.6 mm. Davis, J. H.; Vanden Bout, P. (Univ. of Texas, Austin). Astrophys. Lett.; 15: No. 1, 43-47(Sep 1973).

An experiment is presented which demonstrates that the usual chopper wheel method for calibrating the intensity of a millimeter spectral line does not completely account for atmospheric absorption. An improved expression for the thermal scale determined by this technique is derived and tests confirming its validity are presented. (auth)

16654 NGC3504: A COMPLEX GALAXY WITH A BLUE NUCLEUS. Alloin, D. (Observatoire de Meudon, France); Daphe, Y. A. Astrophys. Lett.; 15: No. 1, 35-37(Sep 1973).

Peculiar stellar properties in the nucleus of the galaxy NGC 3504 are pointed out, namely, the coexistence of two different stellar populations, around B0 and K5 spectral types. A similar behavior has been already noted in other nuclei of barred spiral galaxies, by Vorontsov-Vel'yaminov et al. The emitting gas is found to be moderately excited, with a value $T_e \sim 6 \times 10^3$ K, assuming $N_e = 10^3$ cm^{-3}. The thermal contribution of the gas, shortward to the Balmer jump, is 7 per cent of the observed continuum. A fairly good agreement is obtained between the observed and the synthetic stellar continua. (auth)

16655 SEARCH FOR INTERSTELLAR HDO. Phillips, T. G. (Bell Telephone Labs. Inc., Murray Hill, NJ); Jefferts, K. B.; Wannier, P. G. Astrophys. Lett.; 15: No. 1, 17-19(Sep 1973).

The $1_{1,0}-1_{1,1}$ transition of HDO was sought but not found in the direction of the Orion Nebula. Comments are made concerning the relative abundances of interstellar water and formaldehyde. (auth)

16656 GALACTIC ROTATION AND THE ORIGIN OF DOUBLE RADIO SOURCES. Bridle, A. H.; Brandie, G. W. (Queen's Univ. at Kingston, Ont.). Astrophys. Lett.; 15: No. 1, 21-25(Sep 1973).

Comparison of optical and radio position angles of double radio sources associated with elliptical galaxies usefully reduces the range of double-source models that is compatible with observation. Results from a preliminary investigation readily agree with the predictions of the gravitational-slingshot source model, and with the synchro-Compton model for prolate galaxies. The synchro-Compton model for oblate galaxies, and rotating-magnetoid models, can be supported only if it is assumed that their source-collimating regions carry small fractions of their galaxies' angular momenta. (auth)

16657 FERRIC OXIDE (α-HAEMATITE) IN INTERSTELLAR DUST. Manning, P. G. (Inland Waters Directorate, Ottawa). Nature (London) Phys. Sci.; 245: No. 144, 72-73(1 Oct 1973).

It is stated that recent studies suggest that the 4430 Å diffuse interstellar band represents the crystal-field field-independent transition $^6A_1 \rightarrow {}^4A_1{}^4E(G)$ in octahedral Fe^{3+} ions located in oxide or Si-substituted silicate lattices, with intensity considerations favoring the former, as α- or γ-Fe_2O_3. The author points out that the 4430 Å band halfwidth and a Racah B parameter calculated from the separation of absorption bands in spectra of Type 1 supernovae, when interpreted in the light of next nearest neighbor interactions in terrestrial minerals, are not inconsistent indicators of the presence of ferric oxides, possibly haematite (α-Fe_2O_3). (UK)

16658 DIFFERENCES BETWEEN OLD STELLAR POPULATIONS. van den Bergh, S. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Astron. Astrophys.; 28: No. 3, 469-471(Nov 1973).

It is suggested that the metallicity of stars and globular clusters is correlated with the density of the regions in which they are

formed. The fact that metal-rich stars and globular clusters form preferentially in high-density regions may be understood by assuming that the luminosity function of star formation in dense regions is enriched in massive stars. The high mass-to-light ratios that appear to occur in the low-density outer regions of galaxies might be understood if the luminosity functions in these regions is heavily weighted in favor of low-mass M dwarfs. The differences between the globular clusters in the Galaxy and in the Andromeda Nebula suggest that the cluster system associated with M31 is $\sim 1 \times 10^9$ years older than the galactic globular cluster system. The peculiar horizontal branch morphology of some of the globular clusters near the edge of the galactic globular cluster swarm may be understood if these objects are $\sim 1 \times 10^9$ years younger than are the majority of globular clusters situated closer to the center of the Galaxy. (auth)

16659 OBSERVATIONS OF RADIO EMISSION FROM INTERACTING GALAXIES AT 1415 MHz. Burke, B. F.; Miley, G. K. (Sterrewacht, Leiden). Astron. Astrophys.; 28: No. 3, 379-383 (Nov 1973).

1415 MHz observations of seven optically selected peculiar galactic systems were made with the Westerbork Telescope. Radio emission was detected for six of them. In no case was this emission associated with bridges or tails suggesting that magnetic fields are relatively unimportant in maintaining these structures. For NGC 4038/4039 the radio source is located between the galaxies and its intensity may have been enhanced due to compression of plasma and magnetic field during an encounter. (auth)

16660 POLARIZATION DISTRIBUTION OF ELEVEN 3C RADIO GALAXIES AT 1415 MHz. Miley, G. K.; van der Laan, H. (Sterrewacht, Leiden). Astron. Astrophys.; 28: No. 3, 359-372 (Nov 1973).

Total intensity and polarization distributions at 1415 MHz are given for eleven 3C radio galaxies: 3C 61.1; 66; 184.1; 274.1; 284; 285; 310; 314.1; 390.3; 402; and 465. The polarization structures are more complex than the total intensity distributions and for resolved components the peak polarizations do not coincide with the brightest regions, but are generally found on steep gradients of total intensity. The morphology of the sources is discussed. (auth)

16661 H II REGIONS NEAR THE NUCLEUS OF M 33. Benvenuti, P. (Univ., Padua); D'Odorico, S.; Peimbert, M. Astron. Astrophys.; 28: No. 3, 447-455(Nov 1973).

Photographic spectrophotometry is presented for 24 H II regions and for 7 areas of the "Interarm H II region"; for most of them the relative line intensities of Hα, $\lambda\lambda$ 6584, 6717 and 6731 are given. The presence of a general field of emission in the disc of M33 is confirmed. It is argued that the interarm H II region is ionized by late O and early B-type stars. It is found that the H II regions are of relatively low electron density and that the [N II] and [S II] lines originate in the same volume elements. An abundance ratio of $\log N(N)/N(S) = 0.48$ is derived; this ratio is larger than that of the solar neighborhood and smaller than those of the nuclei of M51 and M81. Similar results are obtained for the interarm H II region. (auth)

16662 SHAPES OF NEUTRAL GLOBULES ASSOCIATED WITH DIFFUSE NEBULAE. Dyson, J. E. (Univ. of Manchester, Eng.). Astron. Astrophys.; 27: No. 3, 459-466(Sep 1973).

A self-gravitating isothermal globule of neutral hydrogen embedded in a diffuse nebula has a shape which depends on the angular distribution of the ultraviolet radiation field incident on its surface. Self consistent structures are calculated for axially symmetric globules exposed to axially symmetric radiation fields. Globules respond with low surface curvature and high surface density towards maxima in the radiation field. Conversely, they respond with high surface curvature and low surface density towards minima in the radiation field. Under certain conditions, a globule may drift slowly towards the minimum in the radiation field. (auth)

16663 MARINER 9 ULTRAVIOLET SPECTROMETER EXPERIMENT: MEASUREMENTS OF THE LYMAN ALPHA SKY BACKGROUND. Bohlin, R. C. (Univ., of Colorado, Boulder). Astron. Astrophys.; 28: No. 3, 323-326(Nov 1973).

During the flight of Mariner 9 to Mars, the ultraviolet spectrometer on board the spacecraft measured the Lα intensity for several points in the sky. These data are compared with a sky map obtained by OGO-5 and the observations of Mariner 6. The absolute calibration of Mariner 9 and Mariner 6 differ by a factor of 1.43 at Lα. The low values of the sky brightness measured by Mariner 9 near the sky minimum suggest that the nearby interstellar medium has a kinetic temperature of 200 to 1100°K and a relative velocity with respect to the Sun in the range 13 to 14 km s^{-1}. (auth)

16664 RADIAL CHANGE OF MEAN FLATTENING OF GALAXIES IN THE COMA CLUSTER. Kalinkov, M. P. (Bulgarian Academy of Sciences, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 8, 1005-1008(1973).

Results of measurements of the diameters of the galaxies of the Coma Cluster were presented previously (Kalinkov, 1970). As was shown, the mean apparent sphericity of galaxies changes with the distance from the center of the cluster. Spherical galaxies predominate around the center. This observation is considered and the change of the sphericity is determined. (WDM)

16665 GALAXY ASSOCIATED WITH QSO 4C37.43. Stockton, A. (Univ. of Hawaii, Honolulu). Nature (London) Phys. Sci.; 246: No. 150, 25(12 Nov 1973).

It is stated that the most convincing demonstration that QSOs are actually at the distances indicated by the Doppler interpretation of their redshifts has been the discovery of normal galaxies at small angular separations from QSOs that have essentially the same red shifts as the galaxies. Five examples of QSOs or related objects apparently in association with galaxies or clusters of galaxies are known, but an additional example of a galaxy having a redshift similar to that of an adjoining bright QSO is here reported. The QSO is 4C37.43, which has an estimated visual magnitude of 15.5 and a redshift $z = 0.370$, and a faint galaxy lies 9.9″ east and 2.4″ south of the QSO. A spectrogram of this galaxy was obtained using an RCA image intensifier with the Cassegrain spectrograph of the Mauna Kea 224 cm. telescope, indicating a mean redshift $z = 0.3736$. The QSO was observed with the same equipment and its redshift found to be $z = 0.3708$. (UK)

16666 LIGHT CURVES AND CHARACTERISTICS OF RECENT SUPERNOVAE. Barbon, R.; Ciatti, F.; Rosino, L. (Univ., Padua). Astron. Astrophys.; 29: No. 1, 57-67(Nov 1973).

For the following supernovae: 1970-g in NGC 5457, 1972 in NGC 3147, 1972-r in NGC 2841, 1972 in NGC 4254, photographic observations in B and V were carried out at Asiago. For SN 1970-g U plates and spectra were also obtained. The epoch and brightness of maximum were deduced, and the membership to Type I or II is discussed. The supernovae in NGC 5457 and in NGC 4254, both of Type II, showed a close resemblance to the SN 1969-1 in NGC 1058, suggesting that a group of SN-II share similar properties. (auth)

16667 STUDIES OF Ir II GALAXIES. I. NGC 4753 AND NGC 5273. Chromey, F. R. (Harvard Univ., Cambridge, MA). Astron. Astrophys.; 29: No. 1, 77-84(Nov 1973).

Photometric observations of NGC 5273 and spectroscopic and photometric observations of NGC 4753 demonstrate that the visible light from these dusty galaxies originates primarily from late-type stars. Eleven-color photometry shows NGC 5273 to have a stellar population typical of a normal elliptical galaxy of low luminosity ($M_V \sim -17.7$). The spectral abnormalities mentioned by Markarian are not apparent in the photometry. Spectroscopy and photometry of NGC 4753 do not provide an unambiguous interpretation of this peculiar galaxy. Interior to a radius of 40 arc seconds, the object is rotating as a solid body, and the masses determined for this region lie in the range 0.9 to 4.4×10^{10} $M_\odot$. Although one reasonable interpretation of the observational evidence implies that NGC 4753 has a population and luminosity identical to those of a normal elliptical with $M_V = -19.7$, other interpretations cannot be entirely ruled out. (auth)

16668 408 MHz FAN-BEAM SURVEY AT LOW GALACTIC LATITUDES. II. The Galactic Continuum Radiation. Felli, M. (Observatorio Astrofisico di Arcetri, Florence); Salter, C. J. Astron. Astrophys.; 29: No. 1, 129-134(Nov 1973).

Contour maps were prepared of the 408 MHz continuum radiation from low galactic latitudes using observations made with the east–west arm of the Bologna cross radiotelescope. They had a resolution of about 4′ in right ascension by 2° in declination. The maps cover Galactic longitudes, $16° \leq l \leq 58°$ and $70° \leq l \leq 90°$, and latitudes, $-4° \leq b \leq +4°$. The maps are presented in equatorial coordinates. (auth)

16669 STATISTICAL STUDY OF INTEGRAL PROPERTIES OF GALAXIES MEASURED IN THE 21-cm LINE. Balkowski, C. (Observatoire de Meudon, France). Astron. Astrophys.; 29: No. 1, 43-55(Nov 1973).

The hydrogen masses, indicative total masses, luminosities, and ratios between these quantities were determined in order to study statistically the integral properties of 149 galaxies measured in the 21-cm line. The important role of type and luminosity in the determination of these properties is shown. Distance criteria are refined, particularly the three-ratio diagram which makes use of type, luminosity, neutral hydrogen mass, and total mass. (auth)

16670 HIGH-RESOLUTION RADIO CONTINUUM OBSERVATIONS OF BRIGHT SPIRAL GALAXIES IN AN OPTICALLY COMPLETE SAMPLE AT 1415 MHz. van der Kruit, P. C. (Ster-

rewacht, Leiden). Astron. Astrophys.; 29: No. 2, 231-247(Dec 1973).

This paper is one in a series in which studies of the radio continuum brightness distribution in bright, nearby spiral galaxies with the Westerbork Synthesis Radio Telescope (WSRT) are reported. The observing frequency is 1415 MHz and the bandwidth is 4 MHz. The synthesized beam is elliptical and the half-power beamwidths at full resolution are 23'' (RA) and 23''/sin δ (Dec). Observations are presented of NGC 598 (M33), 4826, 3031 (M81), 4736, 2403, 2903 and 5055 (M63). These, together with earlier published results comprise all fourteen spiral galaxies brighter than Harvard magnitude 10.5 above declination +15°. The observed distributions have been used to derive, apart from individual interesting features, three important parameters. These are the flux density of the nuclear source, the spiral arm component, and the base disk. (WDM)

16671 FURTHER HIGH-RESOLUTION RADIO CONTINUUM OBSERVATIONS OF BRIGHT SPIRAL GALAXIES AT 1415 MHz. van der Kruit, P. C. (Sterrewacht, Leiden). Astron. Astrophys.; 29: No. 2, 249-262(Dec 1973).

Observations of NGC 4594 (M104), 5866, IC 342, NGC 4321 (M100), 3556 (M108), 628 (M74), 7331, 4939, 1300, 5383, 7640, 7741, 3432, and 3675 are presented. The results are summarized. (WDM)

16672 HIGH-RESOLUTION RADIO CONTINUUM OBSERVATIONS OF BRIGHT SPIRAL GALAXIES AT 1415 MHz: A General Discussion. van der Kruit, P. C. (Sterrewacht, Leiden). Astron. Astrophys.; 29: No. 2, 263-275(Dec 1973).

This paper is a discussion of the radio continuum observations at 1415 MHz of a large set of bright spiral galaxies with the Westerbork Synthesis Radio Telescope. In earlier papers in this series the flux densities of the central radio source, the spiral arm component and the base disk component were determined. From the latter two the "compression strengths" of the density waves were determined. These, the 1415 MHz luminosities of the nucleus and the average face-on brightness temperature of the basic disks are tabulated together with various other properties of the galaxies. (WDM)

16673 STELLAR RINGS AND THE STRUCTURE OF THE GALAXY. Vidal, N. V. (Mount Stromlo and Siding Spring Observatory, Canberra, Australia); Bern, K. A. Astron. Astrophys.; 29: No. 2, 277-287(Dec 1973).

All the present observed individual stellar rings are discussed. The Orion ring is shown to be a chance configuration imbedded in the association Orion OB 1. A complete sample of stellar rings in the region $120° \leq l \leq 150°$ does not show the spiral structure claimed by Isserstedt and Schmidt-Kaler. (auth)

16674 NEUTRAL HYDROGEN STUDY OF HARO GALAXIES. Bottinelli, L.; Chamaraux, P.; Gouguenheim, L.; Heidmann, J. (Observatoire de Meudon, France). Astron. Astrophys.; 29: No. 2, 217-224(Dec 1973).

Twelve Haro galaxies were observed in the 21-cm line of neutral hydrogen with the Nançay radiotelescope. They have a high relative hydrogen content compared to their total mass and luminosity. In spite of this, however, they differ from normal irregulars in their integral properties and chiefly by the large value of their internal velocity spread; moreover they exhibit several properties similar to those of the Markarian and of the Zwicky compact galaxies. (auth)

16675 DYNAMICS OF THE ANDROMEDA NEBULA. Rubin, V. C. Sci. Amer.; 228: No. 6, 30-36(Jun 1973).

The motions of H II regions in M31 are considered in detail. Mass and density distributions are given along with a rotation curve for M31. (WDM)

16676 INTERSTELLAR MOLECULES: THEIR FORMATION AND DESTRUCTION. McNally, D. (London Univ.). Advan. At. Mol. Phys.; 8: 1-38(1972).

Topics covered in this review include: the interstellar medium; the new interstellar molecular species; associative mechanisms for molecule formation; dissociative mechanisms for molecule formation; equilibrium of interstellar molecules; and molecules and star formation. (WDM)

16677 THEORY FOR THE FORMATION OF THE GALACTIC STELLAR HALO. Innanen, K. A.; Keenan, D. (York Univ., Toronto). J. Roy. Astron. Soc. Can.; 67: No. 5, 248-253(Oct 1973).

It is proposed that in order to facilitate star formation before the onset of collapse, the proto-galactic gas cloud fragmented into 600 to 1000 clouds each of mass $\sim 10^7 M_\odot$ and each of which condensed into a dwarf spheroidal galaxy. If their angular momenta were distributed like those of the present globular clusters, the previously condensed galactic nucleus would gravitationally completely disrupt all but a handful of the primordial systems and disperse them into a uniform galactic halo of $\sim 10^{10} M_\odot$, including $\sim 4 \times 10^5$ RR Lyrae stars. It is suggested that the Groombridge 1830 group may be the remnant of such a disrupted primordial dwarf spheroidal. The fact that some of these spheroidals would have little or no angular momentum would lead to energetic direct collisions with the galactic center and possibly to the formation of thermal gas jets. (auth)

16678 GIANT SPIRAL GALAXY M101. I. A High Resolution Map of the Neutral Hydrogen. Allen, R. J.; Goss, W. M.; van Woerden, H. (Univ. of Groningen, Netherlands). Astron. Astrophys.; 29: No. 3, 447-451(Dec 1973).

A preliminary map is presented of the distribution of neutral hydrogen in the Sc I galaxy M 101, with 25'' × 30'' resolution. The H I is mostly arranged in narrow elongated structures, which closely coincide with the spiral arms seen in optical photographs. Several major concentrations of H I coincide with giant H II regions and/or associations; these concentrations have sizes of 1 × 3 kpc and masses $\approx 40 \times 10^6 M_\odot$. In the central parts of the system, no small-scale structure in the hydrogen is detected. The system used in the present observations becomes progressively less sensitive to structures on angular scales larger than about 10'. (auth)

16679 9.7 μ ABSORPTION FEATURE IN THE GALACTIC CENTER. Borgman, J. (Kapteyn Observatory, Roden, Netherlands). Astron. Astrophys.; 29: No. 3, 443-445(Dec 1973).

Narrow-band observations of the 9.7 μ absorption feature in the fine structure of the galactic center are presented and briefly discussed. (auth)

16680 NEUTRAL HYDROGEN STUDY OF THE GALAXY NGC 5236. Bottinelli, L.; Gouguenheim, L. (Observatoire de Meudon, Paris). Astron. Astrophys.; 29: No. 3, 425-429(Dec 1973).

The Sc galaxy NGC 5236 was observed in the 21-cm hydrogen line with the Nançay radio telescope. An asymmetry in the H I distribution was found: there is 20% more H I to the south of the optical center than to the north and the H I center of mass is displaced 5' towards the south with respect to the optical one. The major axis of the neutral hydrogen distribution (PA = 0°) appeared quite different from the optical one (PA = 45°). The study of the velocity field showed that the kinematical major axis position angle varied from 45° to 0° as one considers more and more external regions in the galaxy. The H I center may be taken as the kinematical center. Noncircular motions are superimposed on a circular rotation. The integral parameters of NGC 5236 appear to be quite normal for its morphological type. (auth)

16681 GALACTIC CENTRAL REGION AND CLASSIFICATION OF OUR GALAXY AS SPIRAL NEBULA BASED ON SURFACE-PHOTOMETRY. Schmidt-Kaler, T.; Schlosser, W. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 29: No. 3, 409-414(Dec 1973). (In German).

Photographs of the southern Milky Way in UBV and R obtained by means of a wide-angle spherical mirrow camera were used to determine the dimensions 20° × 34° and the center of the lens-shaped central region of the galaxy. The main body of the Galaxy is estimated to extend to about $R_M = 1.8\ R_\odot = 18$ kpc. The photographs were further used to classify the Galaxy in different classification systems; in the DDO-system it is Sb ($-$ Sb$^+$) I$-$II with a corresponding intrinsic color $C_0 = 0.61 \pm 0.13$, and absolute magnitude $M_{pg} = -19.9 \pm 0.5$ (based on a calibration assuming H = 100 km/s Mpc). The observed color index of the nuclear region of the Galaxy corrected for interstellar reddening is in agreement with what is expected from this classification. The geometrical dimensions obtained for the Milky Way were compared with those estimated from photographs of spiral nebulae of the same type. The flattening of the central region and the relative dimensions of central region D_K and main body D_M agree well with the averages for Sb I$-$II galaxies. The absolute dimensions D_K and D_M appear correlated to type and luminosity class of the spiral nebula. The scatter is about ±35%, but seems largely due to uncertainties of the luminosity classification and errors of the diameter estimates. (auth)

16682 X AND γ RAY ASTRONOMY. Vedrenne, G. Bull. Union Physiciens; 67: No. 557, 1143-1170(Jul 1973). (In French).

The composition of the galaxy is recalled together with the origin of cosmic radiation and its properties. The processes envisaged for the production of x and γ radiation are described, together with the detectors used for studying these radiations. (FR)

16683 UPPER LIMITS TO H I MASS AND CONTINUUM EMISSION AT 1420 MHz IN TWO COMPANIONS OF M31. Guibert, J. Astron. Astrophys.; 29: No. 3, 335-339(Dec 1973).

The two nearest elliptical companions of M31, NGC 221 (M32) and NGC 205, were investigated in the radio continuum and in the hydrogen line at 21 cm with the Nançay telescope. In the continuum, upper limits of 0.15 and 0.2 flux units respectively were found for the two galaxies. The line observations provided new

upper limits to the ratio HI mass/total mass: 0.22 and 0.12 percent respectively. (auth)

16684 LARGE SCALE LINE SPLITTING IN THE ORION NEBULA. Deharveng, L. (Observatoire, Marseille). Astron. Astrophys.; 29: No. 3, 341-346(Dec 1973).

Several interferograms taken in the [N II] line at 6584 Å show a splitting of this line. This splitting extends over distances as large as several minutes of arc and indicates in places velocity differences of up to 25 km s^{-1} along the line of sight. Dyson's globule hypothesis predicts splitting but not over such extended distances; the observations are consistent with an expanding shell model of the regions emitting the [N II] line. (auth)

16685 PHOTOELECTRIC PHOTOMETRY OF GASEOUS NEBULAE. I. The Temperature and Ionization Structure of the Orion Nebula. Dopita, M. A. (Univ. of Manchester, Eng.). Astron. Astrophys.; 29: No. 3, 387-392(Dec 1973).

A self-consistent analysis was made of the photoelectric intensities of the Hα, Hβ, [N II] λ6584 Å, and [O III] λ 5007 Å with a one arc minute beam at ninety points in the Orion Nebula (M42, NGC 1976) in a strip fifty arc minutes long. This yielded a temperature near θ_1 Ori of 9700°K and showed 0.73 of the oxygen is in the form O^{++} at this point. The variation in degree of ionization found showed that M42 is density bounded, and the abundances of oxygen and nitrogen in the ionized gas were found to be $(2.2 \pm 0.3) \times 10^{-4}$ and $(3.4 \pm 0.4) \times 10^{-5}$ respectively. (auth)

16686 LIMITS ON THE RATE OF STAR FORMATION IN THE GALAXY. Truran, J. W. (Yeshiva Univ., New York). Comments Astrophys. Space Phys.; 5: No. 5, 117-124(1973).

An intense period of star formation and nucleosynthesis activity, involving primarily more massive stars, characterized the collapse phase and early history of the disk. The associated monotonic increase in metal content (Z) from very low levels ($\lesssim 10^{-3}Z$) accounts for the range in Z evident in Population II objects and the difference in averaged metal contents between stars of Populations I and II. (WDM)

16687 TIME-DEPENDENCE OF THE LOCAL STELLAR VELOCITY DISTRIBUTION. Byl, J. Vancouver, B. C.; University of British Columbia (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

It is a well-known observational fact that the velocity distribution of a group of stars is related to the spectral classes of the stars. In particular, a large vertex deviation exists for stars of early spectral types, which disappears for stars of later spectral types. Also, the velocity dispersions tend to increase with later spectral types. An examination of the nearby stars yielded relations between the velocity distribution and the spectral type. Since it was possible to estimate ages for a number of stars, the dependence of the velocity dispersions on age could also be determined. It is proposed that the observed effects are due to spiral density waves. If account is taken also of the fact that the orbits of the younger stars are not yet well-mixed, then it is found that the predicted values of the vertex deviation agree quite well with the observational values. The increase in the velocity dispersion can be explained if the spiral pattern has dissolved and reformed a number of times. From a comparison of the theoretical age-dependence of the velocity dispersion and the observational curve it is possible to estimate the number of spiral patterns which have existed, their amplitudes and their decay rates. (Diss. Abstr. Int., B)

16688 EVIDENCE FOR THE EXISTENCE OF GALACTIC SUPERCLUSTERS NEAR THE GALACTIC NORTH POLE. Kalinkov, M. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 6: 71-115(1973). (In Bulgarian).

The author's results on isopleths (1972) are applied to examine the validity of the zero-hypothesis concerning the distribution of galactic clusters. The treatment covers a sampling of galactic clusters with centers situated in regions with galactic populations twice as dense as their average density, and a sampling of galaxies with lower-than-average densities. The median method, the Smirnov criterion (1965), and gamma-distributions are applied to demonstrate the existence of galactic superclusters (second-order galaxies) near the galactic North Pole. The results also suggest that the zero hypothesis should not be considered a well-founded hypothesis. (IAA)

Cosmology

Refer also to abstracts 17506, 17528, and 17532.

16689 PROBLEM OF THE REDSHIFTS. Burbidge, G. R. (Univ. of California, San Diego, La Jolla). Nature (London) Phys. Sci.; 246: No. 150, 17-25(12 Nov 1973).

The observational evidence concerning the nature of the redshifts associated with quasistellar objects and some peculiar galaxies is reviewed under the following headings: Introduction; redshift–apparent magnitude diagram; redshift–angular diameter relation; distribution of redshifts; multiple redshifts; QSOs and nuclei of normal galaxies; variability and relativistic expansion; direct distance measurements; other evidence; and overall situation. 99 references. (UK)

16690 EFFECT OF A LOCAL ABSORBER IN ABSORBER THEORY. Pegg, D. T. (Univ. of North Queensland, Townsville, Australia). Nature (London) Phys. Sci.; 246: No. 151, 40-41 (19 Nov 1973).

It is stated that in a recent experiment (Partridge, Nature 244: 263 (1973)) a null result was found, to 1 part in 10^3, for the effect of a local absorber as the power emitted by a source. This result was interpreted in the framework of absorber theory as setting some constraints on the absorptive properties of the Universe. The present author points out, however, that this conclusion is by no means necessary, and that a time-symmetric static local absorber should have no effect on the power emitted by a source, irrespective of the absorption of the Universe. (UK)

16691 ELECTROSTATIC REDSHIFT. Woodward, J. F.; Crowley, R. J. (California State Univ., Fullerton). Nature (London) Phys. Sci.; 246: No. 151, 41(19 Nov 1973).

Reference is made to Brillouin who in his book "Relativity Reexamined" (1971) refers to some experiments by Kennedy and Thorndike (Proc. Natl. Acad. Sci. USA 17: 620 (1931)) and by Drill (Phys. Rev. 56: 184 (1939)) in which an electrostatic analogue of the gravitational redshift was sought. It is pointed out that these authors did not attempt to deduce theoretically the quantitative prediction of general relativity theory for the electrostatic redshift; they appear to have proceeded in a purely experimental and intuitional fashion. In order to show that their null result was to be expected, and that the electrostatic redshift is inaccessible even with present techniques, a brief derivation of the general relativistic prediction for this effect is given. (UK)

16692 SMOOTHING THE QUANTUM COLLAPSE. Clarke, C. J. S. (Cambridge Univ., Eng.). Int. J. Theor. Phys.; 8: No. 4, 231-235(1973).

A generalization of quantum theory is presented in which the state of the universe is represented by a vector which varies smoothly with time. In the presence of measurements a smoothed-out "collapse" takes place, while in their absence conventional Hamiltonian dynamics are obtained. (auth)

16693 MATTER AND ANTIMATTER IN THE UNIVERSE. Harrison, E. R. (Univ. of Massachusetts, Amherst). Comments Astrophys. Space Phys.; 5: No. 4, 109-115(1973).

The theoretical situation in regards to the matter–antimatter abundances in the universe is reviewed. The various approaches to the problem are discussed in some detail. (WDM)

16694 GRAVITATIONAL WAVE DETECTION BY RESONANT INTERACTIONS WITH AN ELECTROMAGNETIC FIELD. Tourrenc, P.; Crossiord, J. L. (Institut Henri Poincare, Paris). Nuovo Cim.; 19B: No. 1, 105-121(11 Jan 1974). (In French).

Some phenomena of resonance between a gravitational wave and an electromagnetic radiation contained in a cavity are studied; the use of a simplified pattern allows to follow calculations to their end and to pick out orders of magnitude. The whole of this study is done by means of a perturbative method restricted to first order, within Einstein-Maxwell's theory. (auth)

16695 ORIGIN OF THE UNIVERSE. Kundt, W. (Univ., Bielefeld, Ger.). pp 1-22 of Trends in Physics. Petit-Lancy, Switzerland; European Physical Society (1973).

There is a certain amount of evidence that the simplest among all cosmological models, the spherically symmetric zero energy Einstein–de Sitter model, gives a valid description of the world geometry. This evidence comprises all observational data, the instability of spherically symmetric universes, and the nonexistence of reasonable models without a singularity (bang). On the other hand, there are known anisotropic cosmological models which approach an Einstein–de Sitter universe asymptotically at large times. Questions regarding the initial geometry of the world are, therefore, still undecided. Observational facts are considered together with aspects of space–time geometry, expansion equations, cosmic eras, the hadron era, and density fluctuations. (IAA)

Planetary Phenomena

Refer also to abstract 16535.

16696 (N-72-26568) EFFECTS OF RADIATION ON THE OUTER PLANETS GRAND TOUR. (North American Rockwell

Corp., Downey, Calif. (USA). Space Div.). Nov 1971. 308p. (NASA-CR-127065; SD-71-770). NTIS $17.50.

For Jet Propulsion Lab., Pasadena, CA.

A handbook is presented which was designed to accompany an oral presentation on the effects of radiation on the outer planets grand tour (OPGT). A summary of OPGT radiation environments expected from natural sources and the radioisotope thermoelectric generators and basic radiation effects and processes are reviewed, and ionization and displacement effects are examined. The presentation summarizes the effects of radiation on miscellaneous spacecraft materials and devices. The annealing and hardening of electronics are described. Special emphasis is placed on microcircuits. Mathematical modeling of circuits affected by radiation and radiation environmental testing are discussed. A review of means of evaluating the performance and correcting failures of irradiated devices is also presented. (auth) (STAR)

16697 STRUCTURES OF THE TERRESTRIAL PLANETS. Lyttleton, R. A. (Cambridge Univ., Eng.). Nature (London); 246: No. 5428, 84-85(9 Nov 1973).

Comments are made on Bullen's suggestion (Nature 243: 68 (1973)) that the outer core of the Earth may be composed of Fe_2O, to agree with the hypothesis that the Earth, Venus, and Mars have the same overall composition. It is stated that although the possibility that the core consists of Fe_2O cannot be ruled out there seems to be no need to postulate this, or any specific composition, as to its chemical nature, when considering the question of calculation of the internal structures of other planets on the hypothesis that they have the same overall composition as the Earth; only the elastic constants and uncompressed density of the material enter such calculations. A reply by Bullen is appended. (UK)

16698 JUPITER, THE GEOPHYSICIST'S PLANET. Stubbs, P. New Sci.; 60: No. 874, 622-623(29 Nov 1973).

Speculations concerning aspects of the largest planet Jupiter are considered. These include the structure of the planet's atmosphere and interior, the origin of the three types of radio signal received from the planet, its magnetic field, its probable liquid core, the temperatures associated with its atmosphere and finally the Great Red Spot. The thirteen experiments which Pioneers 10 and 11 are carrying out are designed to probe more profoundly than ever before the many questions which remain unanswered up to now. Some of the experiments and the apparatus being used are briefly described. (UK)

16699 WAS THE EVOLUTION OF THE ATMOSPHERE CONTINUOUS OR CATASTROPHIC. Ozima, M. (Tokyo Univ.). Nature (London) Phys. Sci.; 246: No. 151, 41-42(19 Nov 1973).

It is stated that although there appears to be general agreement that the Earth's atmosphere has evolved by degassing from the solid Earth the matter is still controversial. One school of thought considers that the degassing has been a continuous process throughout the Earth's history; an alternative view is that the degassing was catastrophic and due to early catastrophic core formation, the catastrophic degassing model, on the basis of Ar evolution in the atmosphere, is here examined. It is concluded that degassing was continuous if the isotopic ratio $^{40}Ar/^{36}Ar$ is about 1000, as estimated from submarine basalts; but if the high values (>10,000) found in the excess Ar in some ultrabasic rocks represent the isotopic ratio in the mantle, as suggested by some authors, the early catastrophic degassing model cannot be ruled out. Study of the trapped Ar in rocks derived from the mantle would yield crucial information as to the origin of the atmosphere, since the isotopic composition in the mantle and the degassing fraction may be inferred by examining the isotopic ratios or the abundance of the trapped Ar in these rocks. (UK)

16700 PRELIMINARY RESULTS ON THE ATMOSPHERES OF Io AND JUPITER FROM THE PIONEER 10 S-BAND OCCULTATION EXPERIMENT. Kliore, A.; Cain, D. L.; Fjeldbo, G.; Seidel, B. L. (California Inst. of Tech., Pasadena). Science; 183: No. 4122, 323-324(25 Jan 1974).

The preliminary analysis of data from the Pioneer 10 S-band radio occultation experiment revealed the presence of an ionosphere on the Jovian satellite Io (JI) having an electron density peak of about 6×10^4 electrons per cubic centimeter at an altitude of approximately 60 to 140 kilometers. This suggests the presence of an atmosphere having a surface number density of about 10^{10} to 10^{12} per cubic centimeter, corresponding to an atmospheric surface pressure of between 10^{-8} and 10^{-10} bar, at or below the detection threshold of the beta Scorpii stellar occultation. A measurement of the atmosphere of Jupiter was obtained down to the level of about 80 millibars, indicating a large temperature increase at about the 20 millibar level, which cannot be explained by the absorption of solar radiation by methane alone and can possibly be due to absorption by particulate matter. (auth)

16701 GRAVITATIONAL PARAMETERS OF THE JUPITER SYSTEM FROM THE DOPPLER TRACKING OF PIONEER 10. Anderson, J. D.; Null, G. W.; Wong, S. K. (California Inst. of Tech., Pasadena). Science; 183: No. 4122, 322-323(25 Jan 1974).

Preliminary analyses of Doppler data from Pioneer 10 during its encounter with Jupiter indicate that the mass of Io is about 20 percent greater than previously thought and that Io's mean density is about 3.5 grams per cubic centimeter. A determination of the dynamical flattening of Jupiter $(a-b)/a$ (where a is the semimajor axis and b is the semiminor axis) is found to lie in the neighborhood of 0.065, which agrees with the value determined from satellite perturbations. (auth)

16702 PIONEER 10 MISSION: SUMMARY OF SCIENTIFIC RESULTS FROM THE ENCOUNTER WITH JUPITER. Opp, A. G. (National Aeronautics and Space Administration, Washington, DC). Science; 183: No. 4122, 302-303(25 Jan 1974).

The encounter trajectory of Pioneer 10 was selected to carry it through the heart of the trapped radiation zone. A brief summary of the results of the Pioneer 10 encounter is provided. (WDM)

16703 PRELIMINARY PIONEER 10 ENCOUNTER RESULTS FROM THE AMES RESEARCH CENTER PLASMA ANALYZER EXPERIMENT. Wolfe, J. H. (Ames Research Center, Moffett Field, CA); Collard, H. R.; Mihalov, J. D.; Intriligator, D. S. Science; 183: No. 4122, 303-305(25 Jan 1974).

Preliminary results from the Ames Research Center plasma analyzer experiment for the Pioneer 10 Jupiter encounter indicate that Jupiter has a detached bow shock and magnetopause similar to the case at Earth but much larger in spatial extent. In contrast to Earth, Jupiter's outer magnetosphere appears to be highly inflated by thermal plasma and therefore highly responsive in size to changes in solar wind dynamic pressure. (auth)

16704 MAGNETIC FIELD OF JUPITER AND ITS INTERACTION WITH THE SOLAR WIND. Smith, E. J. (Jet Propulsion Lab., Pasadena, CA); Davis, L. Jr.; Jones, D. E.; Colburn, D. S.; Coleman, P. J. Jr.; Dyal, P.; Sonett, C. P. Science; 183: No. 4122, 305-306(25 Jan 1974).

Jupiter's magnetic field and its interaction with the magnetized solar wind were observed with the Pioneer 10 vector helium magnetometer. The magnetic dipole is directed opposite to that of the Earth with a moment of 4.0 gauss R_J^3 (R_J, Jupiter radius), and an inclination of 15° lying in a system III meridian of 230°. The dipole is offset about 0.1 R_J north of the equatorial plane and about 0.2 R_J toward longitude 170°. There is severe stretching of the planetary field parallel to the equator throughout the outer magnetosphere, accompanied by a systematic departure from meridian planes. The field configuration implies substantial plasma effects inside the magnetosphere, such as thermal pressure, centrifugal forces, and differential rotation. As at the Earth, the outer boundary is thin, not diffuse, and there is a detached bow-shock. (auth)

16705 PROTONS AND ELECTRONS IN JUPITER'S MAGNETIC FIELD: RESULTS FROM THE UNIVERSITY OF CHICAGO EXPERIMENT ON PIONEER 10. Simpson, J. A. (Univ. of Chicago); Hamilton, D.; Lentz, G.; McKibben, R. B.; Mogro-Campero, A.; Perkins, M.; Pyle, K. R.; Tuzzolino, A. J.; O'Gallagher, J. J. Science; 183: No. 4122, 306-309(25 Jan 1974).

Fluxes of high-energy electrons and protons are found to be highly concentrated near the magnetic equatorial plane from distances of ~30 to ~100 Jovian radii (R_J). The 10-hour period of planetary rotation is observed as an intensity variation, which indicates that the equatorial zone of high particle fluxes is inclined with respect to the rotation axis of the planet. At radial distances $\lesssim 20\ R_J$ the synchrotron-radiation-producing electrons with energies $\gtrsim 3$ MeV volts rise steeply to a maximum intensity of $\sim 5 \times 10^8$ electrons per square centimeter per second near the periapsis at 2.8 R_J. The flux of protons with energies $\gtrsim 30$ MeV reaches a maximum intensity of $\sim 4 \times 10^6$ protons per square centimeter per second at ~3.5 R_J with the intensity decreasing inside this radial distance. Only for radial distances $\lesssim 20\ R_J$ does the radiation behave in a manner which is similar to that at the Earth. Bursts of electrons with energies up to 30 MeV each lasting about 2 days, were observed in interplanetary space beginning approximately 1 month before encounter. This radiation appears to have escaped from the Jovian bow shock or magnetosphere. (auth)

16706 ENERGETIC ELECTRONS IN THE MAGNETOSPHERE OF JUPITER. Van Allen, J. A.; Baker, D. N.; Randall, B. A.; Thomsen, M. F.; Sentman, D. D.; Flindt, H. R. (Univ. of Iowa, Iowa City). Science; 183: No. 4122, 309-311(25 Jan 1974).

Observations of energetic electrons ($\gtrsim 0.07$ MeV), show that the outer magnetosphere of Jupiter consists of a thin disklike, quasi-trapping region extending from about 20 to 100 planetary radii (R_J). This magnetodisk is confined to the vicinity of the magnetic equatorial plane and appears to be an approximate figure of revolu-

tion about the magnetic axis of the planet. Hard trapping is observed within a radial distance of about 20 R_J. The omnidirectional intensity J_0 of electrons with energy $\gtrsim 21$ MeV within the region $3 < r < 20$ R_J is given by the following provisional expression in terms of radial distance r and magnetic latitude θ: $J_0 = 2.1 \times 10^5 \exp[-(r/a) - (\theta/b)^2]$. In this expression J_0 is particles per square centimeter per second; $a = 1.52$ R_J for $3 \leq r \leq 20$ R_J; and $b = 15°$ for $3 \leq r \leq 10$ R_J, diminishing gradually for larger r. There is tentative evidence for mild effects of the Galilean satellite Europa and possibly Io and Ganymede but not Callisto. (auth)

16707 ENERGETIC PARTICLE POPULATION IN THE JOVIAN MAGNETOSPHERE: A PRELIMINARY NOTE. Trainor, J. H. (Goddard Space Flight Center, Greenbelt, MD); Teegarden, B. J.; Stilwell, D. E.; McDonald, F. B.; Foelof, E. C.; Webber, W. R. Science; 183: No. 4122, 311-313(25 Jan 1974).

A preliminary account of the Jovian encounter as viewed by the Pioneer 10 particle detector systems of Goddard Space Flight Center and the Univ. of New Hampshire is given. The systems were designed to measure the charge, energy, and angular distribution of galactic and solar cosmic rays as well as the energetic particles in the Jovian magnetosphere. (WDM)

16708 RADIATION BELTS OF JUPITER. Fillius, R. W.; McIlwain, C. E. (Univ. of California, San Diego, La Jolla). Science; 183: No. 4122, 314-315(25 Jan 1974).

Pioneer 10 counted relativistic electrons throughout the magnetosphere of Jupiter, with the greatest fluxes being inside 20 Jupiter radii. The peak flux of electrons with energy greater than 50 MeV was 1.3×10^7 per square centimeter per second at the innermost penetration of the radiation belts. (auth)

16709 PIONEER 10 INFRARED RADIOMETER EXPERIMENT: PRELIMINARY RESULTS. Chase, S. C. (Santa Barbara Research Center, CA); Ruiz, R. D.; Muench, G.; Neugebauer, G.; Schroeder, M.; Trafton, L. M. Science; 183: No. 4122, 315-317(25 Jan 1974).

Thermal maps of Jupiter at 20 and 40 micrometers show structure closely related to the visual appearance of the planet. Peak brightness temperatures of 126° and 145°K were measured on the South Equatorial Belt, for the 20- and 40-micrometer channels, respectively. Corresponding values for the South Tropical Zone were 120° and 138°K. No asymmetries between the illuminated sunlit and nonilluminated parts of the disk were found. A preliminary discussion of the data, in terms of simple radiative equilibrium models, is presented. The net thermal energy of the planet as a whole is twice the solar energy input. (auth)

16710 PIONEER 10 OBSERVATIONS OF THE ULTRAVIOLET GLOW IN THE VICINITY OF JUPITER. Judge, D. L.; Carlson, R. W. (Univ. of Southern California, Los Angeles). Science; 183: No. 4122, 317-318(25 Jan 1974).

A two-channel ultraviolet photometer aboard Pioneer 10 made several observations of the ultraviolet glow in the wavelength range from 170 to 1400 angstroms in the vicinity of Jupiter. Preliminary results indicate a Jovian hydrogen (1216 angstrom) glow with a brightness of about 1000 Rayleighs and a helium (584 angstrom) glow with a brightness of about 10 to 20 Rayleighs. In addition, Jupiter appears to have an extensive hydrogen torus surrounding it in the orbital plane of Io. The mean diameter of the torus is about equal to the diameter of the orbit of Io. Several observations of the Galilean satellites also occurred but only a rather striking Io observation was analyzed. If the observed Io glow is predominantly that of Lyman-α, the surface brightness is about 10,000 Rayleighs. (auth)

16711 IMAGING PHOTOPOLARIMETER EXPERIMENT ON PIONEER 10. Gehrels, T.; Coffeen, D.; Tomasko, M.; Doose, L.; Swindell, W.; Castillo, N.; Kendell, J.; Clements, A.; Haemenn-Anttila, J.; Knight, C. K.; Blenman, C.; Baker, R.; Best, G.; Baker, L. (Univ. of Arizona, Tucson). Science; 183: No. 4122, 318-320(25 Jan 1974).

A 2.5-centimeter telescope aboard Pioneer 10 is capable of making two-dimensional spin-scan maps of intensity and polarization in red and blue light at high spatial resolution. During the recent flyby of Jupiter, a large quantity of imaging and polarimetric data was obtained on Jupiter and the Galilean satellites over a wide range of phase angles. (auth)

16712 INTERPLANETARY AND NEAR-JUPITER METEOROID ENVIRONMENTS: PRELIMINARY RESULTS FROM THE METEOROID DETECTION EXPERIMENT. Kinard, W. H.; O'Neal, R. L.; Alvarez, J. M.; Humes, D. H. (Langley Research Center, Hampton, VA). Science; 183: No. 4122, 321-322(25 Jan 1974).

Measurements of the population of meteoroids of mass $\sim 10^{-5}$g were made in interplanetary space through the region of the asteroid belt, to the orbit of Jupiter, and in the near vicinity of Jupiter by the Langley meteoroid detection experiment on Pioneer 10. (WDM)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

16713 (CONF-720535-) INTERNATIONAL CONFERENCE ON AEROSPACE AND AERONAUTICAL METEOROLOGY, MAY 22–26, 1972, WASHINGTON, D. C. (American Meteorological Society, Boston, Mass. (USA)). 1972. 437p.

Separate abstracts were prepared for two of the papers. (WDM)

16714 (CONF-720535-, pp 129-140) RECENT MEASUREMENTS OF THE SOLAR ULTRAVIOLET RADIATION INCIDENT ON THE UPPER ATMOSPHERE AND ITS PENETRATION TO LOWER LEVELS. Drummond, A. J.; Hickey, J. R. (Eppley Lab., Inc., Newport, RI). 1972.

From international conference on aerospace and aeronautical meteorology; Washington, District of Columbia, USA (22 May 1972).

In international conference on aerospace and aeronautical meteorology.

The solar ultraviolet energetic measurements made between 1966 and 1968, from NASA B-57B and CV-990 jet and X-15 rocket research aircraft platforms in the upper troposphere, lower stratosphere, and mesosphere, are discussed. (WDM)

16715 (COO-1340-35) AGE ESTIMATES OF STRATOSPHERIC AIR. Reiter, E. R. (Colorado State Univ., Fort Collins (USA. Dept. of Atmospheric Science). Aug 1973. Contract AT(11-1)-1340. 15p. Dep. NTIS $3.00.

It is shown that careful consideration of $^{32}P/^{7}Be$ ratios (both isotopes being generated in the atmosphere by cosmic radiation) not only yields information on the stratospheric or tropospheric origin of air masses. These ratios may also be used to determine the residence time in the stratosphere of tropospheric air that underwent upward transport through the tropopause and re-entered the troposphere at a later date. (auth)

16716 (DNA-3211-F) INVESTIGATIONS OF ATMOSPHERIC ION–NEUTRAL PROCESSES. Final Report. Ferguson, E. E.; Schmeltekopf, A. L.; Fehsenfeld, F. C.; Albritton, D. L. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Environmental Research Labs.). Jul 1973. 12p. NTIS.

The flowing afterglow developed at National Oceanographic and Atmospheric Administration (NOAA) was used to measure ion–neutral reactions of ionospheric importance. Reactions measured include the fast reaction $S^+ + O_2 \rightarrow SO^+ + O$ which is responsible for S^+ loss in the D region; the reactions of a number of hydrated negative ions, e.g., $O_2^-(H_2O)_{1,2}$, $O_3^-(H_2O)_{1,2}$, and $CO_3^-(H_2O)$, with the neutrals which control their conversion to "terminal" D-region negative ions; and the associative-detachment reactions of a number of negative ions with H atoms. Also studies of the clustering of N_2 to NO^+, which may be of importance in D-region positive ion chemistry, were extended. A new flowing afterglow-drift tube was used to measure the ion kinetic energy dependences of several E- and F-region reactions, $N^+ + O_2$, $N_2^+ + O_2$, and $O^+ + N_2$, from thermal energy to several electron volts in kinetic energy. This same system was used to measure the mobilities of several ions; e.g., NO_3^-, CO_3^-, and $O_2^- \cdot H_2O$ in air. (auth)

16717 (TRITA-EPP-73-14) THEORETICAL AND EXPERIMENTAL CONSIDERATIONS BEHIND BALLOON-BORNE ELECTRIC FIELD EXPERIMENTS. Bostroem, R.; Fahleson, U. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Sep 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

Balloon-borne measurements of electric fields of ionospheric origin are very useful as a complement to rocket and satellite measurements because they make it possible to study the long-term variations. The penetration of ionospheric electric fields to balloon altitudes is reviewed. It is concluded that large-scale components of the horizontal ionospheric fields can be measured at altitudes of 30 to 40 km. However, it is difficult to study ionospheric field variations at frequencies higher than about 0.1 Hz or to resolve spatial structures smaller than about 100 km. Technical problems associated with double-probe measurements at these altitudes are discussed. The usefulness of the method is demonstrated by reviewing some results of previous measurements. (auth)

16718 TROPICAL uv ARCS: COMPARISON OF BRIGHTNESS WITH f_0F_2. Meier, R. R.; Opal, C. B. (Naval Research Lab., Washington, DC). J. Geophys. Res.; 78: No. 16, 3189-3193(1 Jun 1973).

UV emissions from atomic oxygen in the upper atmosphere have been observed near the peaks in the equatorial ionospheric anomaly. Three mechanisms have been proposed as possible sources of the radiation. Although radiative recombination seems to be the most likely candidate for the mechanism by which the radiation is produced, there has been a difficulty in that the calculated emission rates have apparently been lower than those observed. The comparison of the tropical uv airglow with the predictions of radiative recombination theory is reevaluated. (WDM)

16719 THERMOSPHERIC WIND EFFECTS ON THE DISTRIBUTION OF HELIUM AND ARGON IN THE EARTH'S UPPER ATMOSPHERE. Reber, C. A. (Goddard Space Flight Center, Greenbelt, MD); Hays, P. B. J. Geophys. Res.; 78: No. 16, 2977-2991(1 Jun 1973).

The momentum and continuity equations for a minor gas are combined with the momentum equation for the major constituents to obtain the time-dependent continuity equation for the minor species reflecting a wind field in the background gas. This equation is used to study the distributions of helium and argon at times of low, medium, and high solar activity for a variety of latitudinal–seasonal wind cells. For helium the exospheric return flow at the higher thermospheric temperatures dominates the distribution to the extent that much larger latitudinal gradients can be maintained during periods of low solar activity than during periods of high activity. In comparison to the exospheric flow the smoothing effect of horizontal diffusion is almost negligible. The latitudinal variation of helium observed by satellite mass spectrometers can be reproduced by the effect of a wind system of air rising in the summer hemisphere, flowing across the equator with speeds of the order of 100 to 200 m/sec and descending in the winter hemisphere. Argon, being heavier than the mean mass in the lower thermosphere, reacts oppositely to helium in that it is enhanced in the summer hemisphere and depleted in the winter. By using winds that are effective in the lower thermosphere the anomalous vertical helium profiles observed from rockets can be reproduced. The time response of the helium density distribution following the initiation of a wind field implies the likelihood of a density enhancement of a factor of 2 to 4 at night over the daytime values. (auth)

16720 PHASE RADIO METHODS AND THE IMPROVEMENT OF FREQUENCY STANDARDS. Korchak, A. (Izmiran, Moscow). Comments Astrophys. Space Phys.; 5: No. 4, 93-98(1973).

Phase methods include all methods of continuous sounding of the ionosphere, magnetosphere, and interplanetary space, in which either the change of radio signal phase or its time derivative is recorded. The standard phase radio methods are discussed and it is concluded that one of the possible ways of improving existing phase radio methods, taking account of current progress in the improvement of frequency standards, consists of the combination of the three-signal method of medium sounding with the suggestion of transforming the inquiring signal at the spacecraft. (WDM)

16721 IONOSPHERIC MAGNETIC FIELD MEASUREMENTS AT AURORAL LATITUDES. Pendrel, J. V.; Koehler, J. A.; Kavadas, A. (Univ. of Saskatchewan, Saskatoon). Can. J. Phys.; 51: No. 12, 1313-1321(15 Jun 1973).

The magnetometer data from five sounding rocket flights launched from Fort Churchill under a variety of auroral conditions are discussed. The data have been interpreted in terms of model currents which would reproduce the observed magnetic field variations. It was found in some cases that the current systems inferred from the rocket magnetometer were too weak to account for the ground-based magnetometer observations. This suggests that ionospheric current systems must occupy a much larger spatial extent than has generally been assumed in the past. (auth)

16722 BALLOON RECORDINGS OF AURORAL-ZONE X-RAYS FROM NORTHERN NORWAY IN JULY–AUGUST 1965. Trefall, H.; Broenstad, K.; Pytte, T.; Stadsnes, J.; Bjordal, J. (Univ. of Bergen). SPARMO Bull.; 5: No. 2, 111-119(Jun 1973).

Recordings of bremsstrahlung x rays from auroral-zone electron precipitation events, obtained in July and August 1965 by means of balloon-borne detectors launched from sites in northern Norway are presented. An attempt is made to systematically classify these measurements. Comparative studies between these and simultaneous measurements of related phenomena will be encouraged. (FR)

16723 AURORAL INFRASONIC WAVES AND THE POLAR MAGNETIC SUBSTORM. Johnson, R. E. College, AK; Univ. of Alaska (1973). 288p. University Microfilms Order No. 73-23,784.

Thesis (Ph. D.).

The purpose of this thesis was to investigate the relationship

of auroral infrasonic waves to the polar magnetic substorm. The major emphasis was to determine whether or not there are specific regions within the substorm where the infrasound is generated. It was found that the eastern end of the electrojet is a region which is very effective in generating infrasound, and is also a region in which supersonic auroras were observed to be propagating. The magnetic substorm is represented temporally and spatially by use of sequences of contour maps of the total horizontal disturbance vector or the total magnetic disturbance vector. It is shown that attempts to locate the source region of the auroral infrasound generator are futile in the mapping study unless there is some knowledge of the transit speed between the source and observer. A mean horizontal transit speed was derived and found to be near the value of 243 m/sec. Applying the mean horizontal transit speed to centers of intense magnetic activity within the auroral electrojet led to the capability of predicting the onset of coherent pressure disturbances at College, when the station was located near the eastern end of the electrojet. Only feeble infrasound emission was correlated with the western end of the electrojet. Before analyzing the material for four data nights utilized in this study, recognition is given to the multiplicity of types of auroral infrasound and a system of classification is proposed. (Diss. Abstr. Int., B)

16724 IONOSPHERIC METASTABLE PARTICLES. Vlasov, M. N. Vestn. Akad. Nauk SSSR; 63-69(Jul 1973). (In Russian).

A discussion is given on the production and annihilation of metastable particles during photochemical reactions as factors determining the vertical profiles of neutral and ionized particle abundances in the ionosphere. Dissociation under the action of solar uv light, solar light resonance scattering, exothermal photochemical reactions, and electron-induced atmospheric gas excitation are discussed as metastable particle production agents. The important role of metastable particles in the annihilation of negative ions, particularly in the lower ionosphere, is noted. The significance of metastable particle studies for an understanding of the thermodynamic conditions prevailing in the atmosphere is indicated. (IAA)

16725 APPLETON ANOMALY IN THE IONOSPHERIC E REGION. Dominici, P. (Istituto Nazionale di Geofisica, Rome). Ann. Geofis. (Rome); 26: No. 1, 23-28(1973). (In Italian).

A discussion is given on the Appleton seasonal anomaly in the ionospheric E region, as derived from normalized data concerning the E-region critical frequency both by a constant-chi, constant-R method, and a (chi, R) correlation method. It is shown that the amplitude of the anomaly increases with an increase in solar activity and that explanations such as those based on the variation of a single parameter out of all those actually involved are inadequate. It is concluded that in order to take account of the Appleton anomaly in the E region, it will be necessary to apply to the E region mechanisms which have thus far been proposed only for the more extensive anomalies in the F region. (IAA)

16726 DETERMINATION OF THE WIND FIELD FROM THE PRESSURE FIELD AND THE LATITUDINAL EFFECT OF THE GEOMAGNETIC FIELD IN THE IONOSPHERE. Khantadze, A. G. pp 24-29 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

16727 SPACE RESEARCH XIII. Volumes 1 and 2. Proceedings of the Fifteenth Plenary Meeting, Madrid, Spain, May 10-24, 1972. Rycroft, M. J.; Runcorn, S. K. (eds.). Berlin; Akademie-Verlag GmbH (1973). 1143p. (In French and English).

In the sections dealing with artificial earth satellites and remote sensing of the Earth, attention is given to the gravitational field, space metrology, and the Earth's surface and resources. The neutral atmosphere is studied with reference to structure, density and composition, and thermospheric models. Recent progress in ionospheric research is reviewed in terms of neutral and ionic constituents, rocket studies, and disturbance phenomena at high latitudes. Other papers examine the geomagnetic field, the magnetospheric configuration, trapped protons, and very low frequency radiophysics. Solar electrons, protons, flare models, and the solar wind are discussed. Astronomical measurements involving x-ray observations, B type stars, and interstellar hydrogen are described, and some studies of the moon are reviewed. Aspects of cosmic dust are considered. (IAA)

16728 PRELIMINARY RESULTS OF THE CIRCUMLUNAR PLASMA INVESTIGATION. Vasil'ev, M. B.; Vyshlov, A. S.; Kolosov, M. A.; Savich, N. A.; Samovol, V. A.; Samoznaev, L. N.; Sidorenko, A. I.; Shtern, D. Ya. (Inst. of Radiotech. and Electronics, Moscow). Dokl. Akad. Nauk SSSR; 212: No. 1, 67-70(1 Sep 1973). (In Russian).

Relations were determined from which the altitude profile of the electron concentration in the circumlunar space can be found. At 5 to 10 km above the surface lighted by the Sun, the electron concentration is greatest, i.e., of the order of 10^3 per cm^3. The value drops monotonically with increasing distance from the Moon's surface. (TTT)

16729 INVESTIGATION OF THE QUIET F REGION OF THE IONOSPHERE. Khocholava, G. M. pp 15-23 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

In order to evaluate the degree of disturbance of the F2 region at mid-latitudes, it is proposed to use an ionization level of the F2 region defined by magnetically quiet days as the normal state of the ionosphere. An expression for the fluctuations of the critical frequency of the F2 layer, containing the magnetically quiet median of this frequency as a term, is taken as the basic criterion of ionospheric disturbance. The expedience of using a daytime value of plus or minus 10% and a nighttime value of plus or minus 20% for this criterion is demonstrated. (IAA)

16730 NONSTATIONARY MODEL OF CHARGED-PARTICLE DIFFUSION IN A GRAVITATIONAL FIELD. Gvelesiani, A. I.; Khantadze, A. G. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 70: 77-80(Apr 1973). (In Russian).

The nonstationary equation for diffusion under conditions corresponding to the ionospheric F-layer maximum has been solved previously with an assumed constant value of the diffusion coefficient. However, both experiments and the general theory of diffusion indicate that the diffusion coefficient should be variable, and the present study shows that allowance for the change in the diffusion coefficient with height leads to a solution with infinite sums, differing from the previous results. By considering the first six terms of the series, it is possible to describe the spatial and temporal changes in the distribution of charged particle concentration with satisfactory accuracy. (IAA)

16731 REPRESENTABILITY OF SID EFFECTS OBSERVED BY DIFFERENT METHODS. Letfus, V. (Inst. of Geophysics, Sofia). Bull. Astron. Inst. Czech.; 24: No. 4, 191-195(1973).

An evaluation is given of the effectiveness of various observation techniques in detecting sudden ionospheric disturbances during solar flares. The SPA, SWF, and SES methods are found to be the most sensitive in such applications. The effectiveness of the observations of sudden field anomalies in Sofia during solar flares by the SES method is noted. (IAA)

16732 27-DAY VARIATIONS OF THE HARD COSMIC RAY COMPONENT AND THE ATMOSPHERIC OZONE X-LAYER ACCORDING TO IGY DATA. Shatashvili, L. Kh. pp 70-74 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

16733 MOTION OF THE CONDUCTING GAS AT NEUTRAL POINTS OF THE MAGNETIC FIELD. Khantadze, A. G. pp 30-36 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

It has been shown that some phenomena occurring in the ionosphere and in the solar atmosphere can be explained in terms of the property of neutral points to provide free passage of the gas across the magnetic barrier. An exact solution of the magnetohydrodynamics equations for an ideal compressible fluid is obtained and is used to determine all the possible motions of the fluid. (IAA)

16734 ATMOSPHERIC MODELS IN THE REGION FROM 110 TO 2000 km. Jacchia, L. G. (Smithsonian Astrophysical Observatory, Cambridge, MA). pp 225; 227-338 of CIRA 1972: COSPAR International Reference Atmosphere 1972. Berlin; Akademie-Verlag GmbH (1972).

In the discussion of the models attention is given to atmospheric composition, the computation of densities and boundary conditions, temperature profiles, variations in the thermosphere and exosphere, variations with solar activity, the diurnal variation, variations with geomagnetic activity, and the semiannual variation. Other aspects considered include seasonal-latitudinal variations of the lower thermosphere, seasonal-latitudinal variations of helium, variations in hydrogen concentration, density waves, and the drag coefficient. Numerical examples regarding the determination of atmospheric parameters on the basis of the models are also presented. (IAA)

16735 RECENT OBSERVATIONAL RESULTS ON THE THERMOSPHERE AND EXOSPHERE. Roemer, M. (Univ., Bonn). pp 339; 341-377; 379-396 of CIRA 1972: COSPAR International Reference Atmosphere 1972. Berlin; Akademie-Verlag GmbH (1972).

The observational facts on the variations of thermospheric structure are reviewed, taking into account variations with solar

activity, the diurnal variation, variations with geomagnetic activity, the semiannual variation, seasonal–latitudinal variations of helium, variations in hydrogen concentration, and density waves. It is pointed out that the total gas density in the thermosphere and exosphere has been determined from orbital-drag data for more than ten years. These observations made it possible to construct the backbone of a smoothed concept of the density distribution and its systematic variations. High-resolution data on total density, composition, temperature, winds, and waves have become available with the aid of in situ measuring techniques. (IAA)

16736 PHYSICS OF THE NEUTRAL UPPER ATMOSPHERE. Blum, P. (Univ., Bonn); Harris, I.; Priester, W. pp 397; 399-450 of CIRA 1972: COSPAR International Reference Atmosphere 1972. Berlin; Akademie-Verlag GmbH (1972).

Particular attention is given to models of the upper atmosphere that deal with the diurnal variation and the latitudinal density dependence. The upper atmosphere is considered as essentially an ideal gas, or rather a weakly ionized plasma, where physical and chemical processes of considerable complexity take place. The final goal for the theoretical models of the upper atmosphere is to derive the time and space dependence of the physical quantities density, composition, temperature, pressure, and state of motion by theoretical considerations from basic physical assumptions. Questions of the dynamics of the upper atmosphere are discussed together with one- and two-dimensional models of the upper atmosphere, three-dimensional models, the geomagnetic effect, and the semiannual density variation. (IAA)

Magnetospheric Phenomena

16737 (AD-712040) SPLITTING OF DRIFT SHELLS BY THE MAGNETOSPHERIC ELECTRIC FIELD. Report for April–June 1970. Schulz, M.; Roederer, J. G. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Aug 1970. 18p. (SAMSO-TR-70-350). NTIS $3.00.

The dawn-to-dusk magnetospheric electric field E breaks the pitch-angle degeneracy of particle drift shells in a magnetic-dipole field. For particles of sufficiently large kinetic energy T, the expression for the associated radial-diffusion coefficient is given. The coefficient of pitch-angle diffusion is roughly half the reciprocal lifetime. In the absence of pitch-angle scattering, the electric splitting of drift shells constitutes an important adiabatic phenomenon. (auth)

16738 (BMBW-FB-W-72-24) REPORT ABOUT THE EXTENDED MISSION OF THE SATELLITE INJUN-V. Muench, J. W.; Pilkington, G. R.; Kirsch, E.; Hente, B. (Zentralstelle fuer Luft- und Raumfahrtdokumentation und -information, Munich (F. R. Germany)). Aug 1972. 67p. (In German). NTIS (U. S. Sales Only).

This report presents the scientific aims of the INJUN V extended mission, and a short description of the satellite and its experiments. Further, the behavior of the spacecraft during the extended mission is reported and examples of the first data are given. (auth)

16739 (N-73-22746) THEORETICAL ANALYSIS OF WAVE–PARTICLE INTERACTIONS IN THE MAGNETOSPHERE AND SOLAR WIND. Final Report. (TRW Systems Group, Redondo Beach, Calif. (USA)). 15 Apr 1973. 14p. (NASA-CR-131573; TRW-22935-6004). NTIS $3.00.

The theoretical calculation of a beam-plasma interaction, and theoretical calculations on high power antenna-plasma coupling are discussed along with the polar cusp-magnetosheath interface. (STAR)

16740 (N-73-30695) THEORETICAL STUDY OF NONLINEAR WAVES AND SHOCK-LIKE PHENOMENA IN HOT PLASMAS. Final Report. Fried, B. D.; Banos, A. Jr.; Kennel, C. F. (California Univ., Los Angeles (USA)). 29 May 1973. 9p. (NASA-CR-132808). NTIS $3.00.

Summaries are presented of research in basic plasma physics. Nonlinear waves and shock-like phenomena were studied which are pertinent to space physics applications, and include specific problems of magnetospheric and solar wind plasma physics. (STAR)

16741 (N-73-30797) DAYSIDE MIDLATITUDE PLASMA TROUGH. Miller, N. J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jul 1973. 25p. (NASA-TM-X-70436; X-621-73-181). NTIS $3.25.

The electrostatic probe experiment aboard the ISIS-1 satellite detects a quasi-stable dayside plasma trough in the protonosphere with a characteristic time of at least 2 weeks. This behavior contrasts with measurements at 1000 km from Explorer-22, which indicate a trough of a characteristic time less than a satellite orbit period. Associated with the protonospheric trough is an electron temperature maximum approximately 6000°K that is sharp at midnight and broad at noon. In spring and summer, a second noontime temperature maximum often appears poleward of 70 invariant latitude, accompanied by an enhancement in the ionization. The ISIS-1 data indicates that local processes such as dayside F-region photoionization and ionization by energetic cusp particles produce enhancements in plasma density and electron temperature. These enhancements modify the plasmaspheric boundary to varying degrees along a magnetic field tube, thus leading to a plasmaspheric boundary with distinctive features at various positions along a field tube. (STAR) (auth)

16742 THEORY AND COMPUTER SIMULATION OF WHISTLER TURBULENCE AND VELOCITY SPACE DIFFUSION IN THE MAGNETOSPHERIC PLASMA. Ossakow, S. L.; Ott, E.; Haber, I. (Naval Research Lab., Washington, DC). J. Geophys. Res.; 78: No. 16, 2945-2958(1 Jun 1973).

The nonlinear development of unstable whistler waves and their interaction with electrons in an anisotropic, collisionless, magnetospheric-type plasma was investigated by theory and computer simulation experiments. A two-component plasma was considered; a hot electron Maxwellian component with 60° loss cone is superimposed on a cold isotropic electron background. The linear and quasi-linear theory was developed, and quasi-linear theory was used to obtain equations for the temporal evolution of the parallel and perpendicular energy for the hot and cold plasma components. The computer code followed the nonrelativistic dynamics of a large number of charges in their self-consistent electromagnetic fields. Three velocity and one spatial dimension were used. The simulation automatically included energy as well as pitch angle diffusion. The 6.5×10^4 electrons, which were followed, were distributed into the two components. Initially, the wave magnetic energy grows according to linear theory; the hot electrons diffuse into the loss cone, gaining parallel and losing perpendicular kinetic energy by both pitch angle and energy diffusion; and the cold background gains perpendicular energy nonresonantly. The quasi-linear equations for the evolution of parallel and perpendicular energy for the hot and cold components explain the partitioning of energy. A plot of hot particle density in $v_\perp$ versus $v_\parallel$ velocity space shows a hole developing as the particles diffuse, in agreement with theory. It is observed that, as the hot electrons isotropize, the initially unstable higher mode numbers sequentially switch off; i.e., the spectrum shifts to lower k values. The growth of the wave magnetic energy saturates in a full nonlinear phase when the average growth rate is of the order of the electron trapping frequency in the whistler spectrum. At this time there exists a large residual kinetic energy anisotropy in the hot particle distribution. (auth)

16743 WAVE POLARIZATIONS OF GEOMAGNETIC PULSATIONS OBSERVED IN HIGH LATITUDES ON THE EARTH'S SURFACE. Inoue, Y. (Univ. of Pittsburgh). J. Geophys. Res.; 78: No. 16, 2959-2976(1 Jun 1973).

A new theory is put forward, which accounts for the general characteristics of wave polarizations of low-frequency geomagnetic pulsations observed in the auroral and subauroral zones on the Earth's surface. Because the displacement current can be neglected in the neutral atmosphere, the character of the polarization ellipses observed on the ground surface depends on the functional form of the localization of the pulsation disturbance. Whenever a pulsation has an elliptical polarization in a horizontal plane on the ground surface, the disturbance should be bidirectionally localized; in one direction the perturbation is propagative and in the direction orthogonal to the propagation direction it is specified by a stationary function having a sharp peak at the center line of activity. As a result, a train of magnetic potential eddies travels along the auroral zone in the neutral atmosphere near the Earth's surface. The observed polarization reversals between morning and afternoon hours, between geomagnetically conjugate stations, and across the auroral zone are consistently explained by the proposed mechanism. To test this mechanism, a series of computer simulations was performed. A new way of mapping the magnetospheric convection pattern is also proposed by utilizing the global distribution of the wave polarization of geomagnetic pulsations observed on the Earth's surface. (auth)

16744 MAGNETIC FIELD OF A HORIZONTAL CURRENT ABOVE A CONDUCTING EARTH. Park, D. (Williams Coll., Williamstown, MA). J. Geophys. Res.; 78: No. 16, 3040-3043 (1 Jun 1973).

General formulas are derived for the magnetic field produced at the surface of a plane Earth of uniform conductivity by a fluctuating primary current filament in the upper atmosphere. The results are expressed where possible in formulas amenable to hand calculation, and an image construction is given for use when the skin depth is small. Finally, a simple recipe permits fields to be calculated when the primary current is distributed in a horizontal band. (auth)

16745 FINE STRUCTURE OF Pc 1 PULSATIONS. II. Theoretical Interpretation. Roux, A. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France); Gendrin, R.; Wehrlin, N.; Pellat, R.; Welti, R. J. Geophys. Res.; 78: No. 16, 3176-3181(1 Jun 1973).

In an earlier letter [Wehrlin et al., 1973], experimental evidence was given that demonstrated that almost all the Pc 1 events do present a fine structure and that strongly suggests that this fine structure is a consequence of nonlinear phenomena taking place inside the magnetosphere. Furthermore, it was shown that the amplitude reached by the "mother" line when the "daughter" appears is significantly lower than the final saturation level of both the mother and the daughter lines. In this letter a tentative interpretation of both the frequency separation between the different lines and their saturation level is given. Other possible mechanisms are also discussed. (auth)

16746 QUIET TIME MAGNETOSPHERIC FIELD DEPRESSION AT 2.3 TO 3.6 R_E. Sugiura, M. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 78: No. 16, 3182-3185(1 Jun 1973).

OGO-5 flux gate magnetometer data are presented to establish the existence of large field depressions under conditions of varying degree of disturbance at distances ranging from 2.3 to 3.6 R_E at all local times. The results also provide the average ΔB at these distances when Dst, as being derived at present, is zero. (WDM)

16747 VLF EMISSIONS FROM THE MAGNETOSPHERE. Sudan, R. N. (Cornell Univ., Ithaca, NY); Denavit, J. Phys. Today; 26: No. 12, 32-39(Dec 1973).

Discrete emissions need to be triggered by some phenomena, and the triggering mechanisms for vlf magnetospheric emission include whistlers and powerful audiofrequency transmitters. A theory is considered that accounts for such artificially triggered emissions and the results of some numerical simulations that test the validity of the theory are given. (WDM)

16748 USE OF CHARGED PARTICLE BEAMS FOR LOW TEMPERATURE PLASMA MEASUREMENT AND INTERPLANETARY SPACE. Kawashima, N. (Tokyo Univ.). Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 9: No. 2, 451-457(May 1973). (In Japanese).

A new method is proposed to control a spacecraft potential in the magnetosphere and interplanetary space in order to measure basic plasma parameters especially for the low-temperature component of plasma. A pulsed beam is ejected from a spacecraft and a counter streaming plasma current I_c into the spacecraft is measured. The space potential of ambient plasma is identified from the bend on the time variation of the $(dI_c/dt)/I_c$ curve and the density and temperature of plasma can be obtained from the values of $(dI_c/dt)/I_c$ and I_c at the space potential. Another method to use an amplitude modulated electron beam is also proposed and further application is discussed in detail. (auth)

16749 INVESTIGATIONS OF THE BEHAVIOR OF HIGH-ENERGY PROTONS AND ELECTRONS IN THE INNER MAGNETOSPHERE. Haeusler, B. Munich; Technische Univ. (1972). 171p. (In German).

Thesis.

Measured values are discussed which were obtained by means of proton and electron detectors sensitive in the MeV range, on board the German research satellite AZUR, in the radiation belt and above the polar cap. These measurements were made to determine the changes in the distribution of the high-energy particles in the geomagnetic field and thus to gain some insight into the production, loss, and transport processes of these particles. Furthermore, the attempt was made to use the values obtained on the behavior of these particles, especially during a strong geomagnetic substorm and during single, isolated substorms in the magnetosphere, to draw some conclusions as to the changes occurring during these events in the configuration of the magnetosphere. (auth)

16750 CAN THE MAGNETOSPHERIC ELECTRIC FIELD PENETRATE TO THE LOW-LATITUDE IONOSPHERE. Wolf, R. A.; Jaggi, R. K. (Rice Univ., Houston, TX). Comments Astrophys. Space Phys.; 5: No. 4, 99-107(1973).

The rush of the solar wind past the magnetosphere causes a large-scale circulation of plasma, and a corresponding convection electric field, in the outer part of the magnetosphere. The theoretical argument against the magnetospheric electric field's being able to penetrate into the low-latitude ionosphere is restated and discussed. (WDM)

16751 ORIGIN OF THE ELECTRIC FIELD OF POLARIZATION IN A GRAVITATIONAL PLASMA. Fridman, M. (Univ., Liege). Can. J. Phys.; 51: No. 5, 587-591(1 Mar 1973).

The theories developed to explain the expansion of charged particles from the atmosphere always involve an electric field of charge separation of gravitational origin. A theory is proposed replacing the quasi-neutral sources by a plasma polarization due to the external field of gravity. Assuming that the penetrated Debye clouds are distorted by gravity and hence provide the sources, the induced changes in the correlation function are evaluated. The formalism giving the polarization electric field is verified by using the solution of the differential equations for gravitation correlation in the simplest case of an electron and single ion plasma. (auth)

16752 VLF RAY TRAJECTORIES IN A LATITUDE-DEPENDENT MODEL OF THE MAGNETOSPHERE. Walter, F. (Inst. of Technology and Aeronautics, Sao Paulo); Scarabucci, R. R. Radio Sci.; 9: No. 1, 7-15(Jan 1974).

Ray paths of vlf waves that propagate inside the magnetosphere are studied. The model of the magnetosphere is composed of electrons and ions, and includes latitudinal gradients of composition; the propagation is treated on the magnetic meridian. It is found that the presence of ions together with the latitudinal gradients generates ray paths with very peculiar features. The paths of the rays are combinations of trajectories influenced by the gradients of composition, magnetic reflections (ion effect), and reflections at the steep gradients of the plasmapause. The related whistler study provides an alternative explanation of several properties of whistler trains, without the use of field-aligned ducts of enhanced ionization. (auth)

16753 NATURE OF THE POLARIZATION OF GEOMAGNETIC MICROPULSATIONS OF π 2 TYPE. Kiziriya, L. V. pp 64-69 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

16754 DIFFERENCES BETWEEN GEOMAGNETIC STORMS WITH GRADUAL AND SUDDEN COMMENCEMENTS. Berishvili, G. P. pp 5-14 of Certain Problems Concerning Solar-Terrestrial Links and Physics of the Atmosphere. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

The differences between the physical phenomena which accompany Sc-storms and G-storms were studied on the basis of data compiled over several 11-year cycles. Analysis of these differences revealed a distinct difference between the origins of the solar corpuscular fluxes responsible for Sc- and G-storms. (IAA)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 15793, 15795, 16160, 16205, 16348, and 16845.

16755 (IPNO-72-6) PRODUCTION OF A Fe^- BEAM BY CATHODE SPUTTERING IN A PENNING SOURCE. Dumail, M.; Lottet, G. C. (Paris-11 Univ., 91, Orsay (France)). 1972. 7p. (In French). Dep. NTIS (U.S. Sales Only) $3.00.

A Fe^- ion source was developed which operates by cathode sputtering and uses a Penning source without a furnace. Krypton is used to operate the source; extraction was initially effected at a position equidistant from the two cathodes and then from an excentric position. It was possible to obtain particle fluxes ranging from 10^9 particles/cm^2 to 10^{12} particles/cm^2 for irradiations ranging from 1 second to 1 hour by varying the Fe^{10+} current from 2 to 4.10^{-10}A. (FR)

16756 SOURCE OF METALLIC IONS. Lebedev, S. Ya.; Panin, S. D. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 868-869(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 179-180(1973).

The construction of a universal ion source that allows ion beams consisting of Ar, Kr, He, N, C, O, Ne, Cu, Ni, Fe, etc., to be obtained is presented. (auth)

16757 TWO AND FOUR QUADRANT GATING CIRCUITS FOR CROSSED ATOMIC BEAM EXPERIMENTS. Williams, J. F.; Willis, B. A.; Devlin, C. R. (Queen's Univ., Belfast). Rev. Sci. Instrum.; 44: No. 8, 1114-1117(Aug 1973).

Descriptions are given of two circuits which generate scaler gating pulses and beam modulating pulses as required for crossed atomic beam experiments. For the case when only one of the crossed beams is modulated, a circuit is described in which a sinusoidal-type is filtered by a tuned amplifier whose gain is 2000 and Q value is 260, and then passes through a level crossing detector, a frequency doubler, and several variable delays to produce two complementary square wave pulses. When both atomic beams are modulated, a second circuit produces a scaler gating pulse from each of the quadrants of the modulating period. Several combinations of variable delays permit variable phase differences between each of the four gating pulses. Circuit stability is better than 0.01%. (auth)

16758 CARBON K-SHELL X-RAY PRODUCTION BY HEAVY-ION IMPACT IN GAS TARGETS. Tawara, H.; de Heer, F. J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 68: No. 3, 607-614(15 Sep 1973).

The cross sections of carbon K-shell x-ray production were measured for C^+, N^+, and Ne^+ on CH_4 and for C^+ on N_2 and Ne between 28 and 145 keV. The data in CH_4 gas were compared with those of Der et al. and of Terasawa for the same projectiles incident on graphite. Generally the cross sections for the gas target are smaller. The relative magnitude of the different cross sections is in agreement with qualitative predictions according to the electron-promotion model. (auth)

16759 ANISOTROPIC EMISSION IN SINGLE-CRYSTAL SPUTTERING MEASUREMENTS ON HCP SINGLE CRYSTALS. Hofer, W. O. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main). Radiat. Eff.; 19: No. 4, 263-270(Aug 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Aug 1973).

The ejection characteristics of single crystals of zinc, magnesium (hcp) and aluminum (fcc) were determined by bombarding various crystal surfaces with a beam of inert gas ions (Xe^+, Ar^+ and Ne^+). The energy of the bombarding ions varied between 10 and 40 keV. The sputtered particles were collected on cooled, hemicylindrical metal collectors; with the help of an electron probe the thickness of the deposit was measured. Pronounced anisotropic emission was observed in all cases, although random emission comprises the major part of the total ejection. By comparing the $\langle 20\bar{2}3 \rangle$ ejection, which is produced by pure surface collisions, and the $\langle 11\bar{2}0 \rangle$ ejection, where focusing collisions are involved, it is deduced that surface collisions are mainly responsible for the anisotropic emission. The width of both emission distributions increases linearly to the same extent in the temperature regime between 100 and 370 K. The agreement of the Mg $\langle 11\bar{2}0 \rangle$ ejection with the $\langle 110 \rangle$ ejection from an aluminum (111) single crystal is good and thus allows a comparison with the gold $\langle 110 \rangle$ ejection reported in the literature. The assisted focusing ejection in $\langle 0001 \rangle$, which is very pronounced in zinc single crystals and strongly influences the $\langle 20\bar{2}3 \rangle$ ejection from the basal plane, does not show up in magnesium. No. $\langle 111 \rangle$ ejection occurred in aluminum either. In both cases the weak repulsive potential of the low-Z atoms accounts for the lack of this preferential emission. (auth)

16760 DETERMINATION OF NEGATIVE ION YIELD OF Cu SPUTTERED BY Cs IONS. Abdullaeva, M. K.; Ayukhanov, A. K.; Shamsiev, U. B. (Tashkent Inst. of Electronics). Radiat. Eff.; 19: No. 4, 225-229(Aug 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Sep 1972).

This paper describes the determination of secondary ion yields for negative ions obtained by bombardment of copper by cesium ions. Stable and reproducible surface conditions are reached by high-rate sodium deposition simultaneously with sputtering. An optimum thickness of sodium corresponding to about one monolayer is found. Total negative ion yields K_Σ^- are measured by a double modulation technique. Individual negative ion yields K_i^- are then found by mass spectrometrically determining the various negative ion intensities, the sum of which relates linearly to K_Σ^-. This method is based on the assumption of an equal angular and energy distribution of all sputtered negative ions. Data are given for K_Σ^- and K_{Cu}^- and K_O^-. The dependence of K_Σ^- on primary ion energy (500 to 2500 eV) is similar to ordinary sputtering which points to the same basic mechanism in both cases. (auth)

16761 ACCOMMODATION COEFFICIENTS FOR LOW-ENERGY IONS ON METAL SURFACES. Arifov, U. A.; Gruich, D. D.; Ermakov, G. E.; Parilis, E. S.; Turayev, N. Y.; Umarov, F. F. (Tashkent Inst. of Electronics). Radiat. Eff.; 19: No. 4, 219-223 (Aug 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Ger. (Sep 1972).

The interaction of low-energy ions (E = 3 to 100 eV) with the surface of a solid cannot be treated in terms of gas dynamics. The scattering of particles at an energy of $E_0 > 20$ eV may be explained in terms of binary collisions with the atoms of the target. The validity of the single-collision model with free surface atoms for medium energies from 10 to 100 eV and even down to 1 eV was confirmed on the basis of both experimental and computational data. This paper describes experimental studies of the secondary ion emission from the (100) and (110) faces of a Mo single crystal and both experimental and theoretical studies of alkaline ion accommodation coefficient on polycrystalline Mo within the energy range E = 3 to 50 eV with a varying direction of the primary ion beam from normal to the glancing angle of incidence (ϕ = 0 to 75°). On the basis of the retarding potential method using a spherical condenser whose central electrode was the target, the energy distribution of secondary ions was measured. Calculations were performed for the energy of scattered ions and the high-energy portion of accommodation coefficient on the basis of single and double binary collisions using the Born–Mayer potential and taking into consideration the influence of adsorption forces at the surface of the target. (auth)

Atomic and Molecular Properties

Refer also to abstracts 15345, 16816, and 17964.

16762 ELECTRONIC SPECTRA OF Bk^{4+} AND THE SPIN–ORBIT COUPLING DIAGRAM FOR f^7: Eu^{2+}, Gd^{3+}, Tb^{4+}, Am^{2+}, Cm^{3+}, Bk^{4+}. Varga, L. P.; Baybarz, R. D.; Reisfeld, M. J. (Oklahoma State Univ., Stillwater). J. Inorg. Nucl. Chem.; 35: No. 12, 4313-4317(Dec 1973).

Measurements are reported for solution absorption spectra and spectroscopic assignments for $^{249}Bk^{4+}$ in 0.5 M HDEHP-dodecane. The f^7 free-ion intermediate spin-orbit coupling diagram for Eu^{2+}, Gd^{3+}, Tb^{4+}, Am^{2+}, Cm^{3+}, Bk^{4+}, based on various experimental and theoretical estimates, is used to interpret the solution absorption spectrum of Bk^{4+} and to predict the spectrum of Am^{2+}. (UK)

16763 COMPRESSED HYDROGEN ATOM. Savukynas, A. Yu.; Chizhyunas, A. R. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 3, 349-353(1973). (In Russian).

The behavior of the energy parameter of the compressed hydrogen-like atomic systems under the boundary condition $R(r_0) = 0$ for the radial orbitals in considered r_0 being finite. The theorems for the roots of the confluent hypergeometric function are used. The expression for the pressure ionization radius in terms of the quantum numbers of the states, and its values are obtained. (auth)

16764 INVESTIGATION OF EFFECTIVE POTENTIAL BARRIER IN RARE-EARTH ATOMS. Kiselev, A. A.; Karosene, A. V.; Karaziya, R. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 3, 375-385(1973). (In Russian).

The conditions for the existence of a positive effective potential barrier in rare-earth atoms are examined. The solutions of Hartree–Fock equations were used. The dependence of this barrier on the atomic states as well as on the number of electrons in $4f^N$-shell was investigated, the phenomenon of collapse being taken into account too. The generality of features discovered was discussed. (auth)

16765 L-SHELL PHOTOELECTRIC CROSS-SECTIONS OF GAMMA RAYS. Siva Sankara Rao, K.; Aruna Prasad, G.; Parthasaradhi, K. (Andhra Univ., Waltair, India). J. Mines, Metals Fuels; 21: No. 5, 153-161(May 1973).

Investigations are made in the energy region 25 to 110 keV on L-shell photoelectric cross sections in the elements W, Au, Pb and U. It is observed that the maximum contribution of coherent and incoherent cross sections to the total gamma-interaction cross section is of the order of 30% even at 110 keV in U. The L-shell cross sectional values are compared with the theoretical values of Schmickley and Pratt. The errors in the reported L-shell cross sections do not exceed 8%. The agreement between theory and experiment is within 10% except in U at 25 keV. (auth)

16766 ELECTRIC DIPOLE TRANSITIONS IN HD. Poll, J. D.; Karl, G. (Univ. of Guelph, Ont.). Can. J. Phys.; 51: No. 5, 594-596(1 Mar 1973).

The amplitude of the $\Delta\nu = 1$ electric dipole transitions in HD is estimated to be roughly 8×10^{-5} D. (auth)

16767 PROPERTIES OF ATOMS IN MOLECULES. A Proposed Method for Calculating the Extent of Distortion of an Atom. Politzer, P.; Elliott, J. D.; Meroney, B. F. (Louisiana State Univ., New Orleans). Chem. Phys. Lett.; 23: No. 3, 331-334 (1 Dec 1973).

A procedure for calculating the extent of distortion of an atom in a molecule is proposed and applied to the first- and second-row diatomic hydrides. The atomic charges in these molecules were also computed. (auth)

16768 SIMPLE O(4,2) APPROXIMATION FOR HYDROGENIC COULOMB INTEGRALS. Wulfman, C.; Kumei, S. (Univ. of the Pacific, Stockton, CA). Chem. Phys. Lett.; 23: No. 3, 367-369 (1 Dec 1973).

Repulsion integrals for electrons with hydrogenic wave functions are expressed in terms of operations of the Lie algebra of the group $O(4,2) \times O(4,2)$. The result is used to obtain approximate expressions for Coulomb integrals as functions of hydrogenic quantum numbers. (auth)

16769 QUASI-ATOMIC L-MM AUGER SPECTRA OF SOLID Cu AND Zn. Yin, L. (Goddard Space Flight Center, Greenbelt, MD); Adler, I.; Tsang, T.; Chen, M. H.; Crasemann, B. Phys. Lett.; 46A: No. 2, 113-114(3 Dec 1973).

Experimental L_2-$M_{4,5}M_{4,5}$ Auger spectra of metallic Cu and Zn show distinct characteristics of free-atom spectra but do not reflect the band structure. This quasi-atomic phenomenon in solids is tentatively explained as electron localization due to increased screening. (auth)

16770 PROPERTIES OF A NEW NONDIFFERENTIATING METHOD FOR STUDYING STRUCTURES IN THE PRESENCE OF A DISTORTED BACKGROUND. Carbonneau, R.; Bolduc, E.; Marmet, P. (Laval Univ., Quebec). Can. J. Phys.; 51: No. 5, 505-509(1 Mar 1973).

A recently reported mathematical treatment is analyzed, which improves the detection of structures located over a strong continuum. This method does not have the drawbacks of the commonly used differentiation and may be used as an adjustable filter, selecting structures according to their natural width. Detection of autoionizing states in argon and measurement of the energy shift between the ionization thresholds of H_2 and D_2 are presented, as examples of application. (auth)

16771 MOTIONAL NARROWING AND OTHER EFFECTS IN THE Q BRANCH OF HD. Dion, P.; May, A. D. (Univ. of Toronto). Can. J. Phys.; 51: No. 1, 36-39(1 Jan 1973).

Observations of the Q(J) lines in the Raman spectrum of HD are reported for a range of densities at room temperature. The broadening of the individual components at low densities and the eventual overlap and collapse of the band at high densities is shown to be in agreement with the theory of motional narrowing of Alekseev and Sobel'man. A brief comparison of the broadening and shifting of the Q branch of HD with that for H_2 is made. (auth)

16772 RELATIVISTIC HARTREE–FOCK CALCULATIONS OF SOME PROPERTIES OF RARE EARTH ATOMS AND IONS. Coulthard, M. A. (Monash Univ., Clayton, Australia). J. Phys., B (London); 6: No. 11, 2224-2235(Nov 1973).

Relativistic Hartree–Fock results for one-electron energy eigenvalues and $\langle r^n \rangle$, Slater integrals, ionization energies and hyperfine interaction integrals in a number of rare earth atoms and ions are presented. The magnitude of relativistic and exchange contributions in each case is discussed by comparison with relativistic Hartree–Fock–Slater, relativistic Hartree and nonrelativistic Hartree–Fock calculations. Inclusion of relativity and a full treatment of exchange are shown to be essential if detailed agreement with experiment is required. However, because the atomic ground states are usually near the LS coupling limit, the calculations for single jj coupling configurations are not adequate for quantitatively treating properties which involve the 4f electrons directly. (auth)

16773 ACCURATE NUMERICAL DETERMINATION OF TWO- AND THREE-BODY DISPERSION FORCES. Stewart, R. F. (Univ. of Glasgow). J. Phys., B (London); 6: No. 11, 2213-2219 (Nov 1973).

A new computational method for the evaluation of dispersion coefficients between atoms is described. Results are given for the two-body coefficients through R^{-19} for a representative selection of one and two-electron atoms, the uncoupled Hartree approximation being employed in the latter case, and also the leading nonadditive three-body terms are calculated for triplets of hydrogen and helium. Particularly refined computations are described for atomic hydrogen, values of 6.499 026 705 and 21.642 464 54 au being obtained for the dipole-dipole and triple-dipole coefficients respectively. (auth)

16774 S STATE ENERGIES FOR He AND Li^+ USING A SIMPLE CORRELATED TRIAL FUNCTION. Haskins, P. J. (Oxford Univ.). J. Phys., B (London); 6: No. 11, 2220-2223 (Nov 1973).

The trial function suggested recently by Power and Somarjai (Phys. Rev. A; 5: 2401-3 (1972)) was tested by the calculation of upper and lower energy bounds for the ground states of He and Li^+. Upper bounds were also computed for the next seven singlet, and the first seven triplet, states of both species. (auth)

16775 STARK EFFECT FOR THE HYDROGEN ATOM. Yakushin, V. I. (Perm Pedagogical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 123-124(1973). (In Russian).

The parabolic and spherical quantum numbers, characterizing the states of the hydrogen atom, were compared. The dependence of the displacement of the violet components of the $H\gamma$ line of the Balmer series on the intensity of the electric field was shown. The results of the comparison of the energy level values in strong fields, obtained by the Bubnov-Galerkin method and the Wentzel-Kramers-Brillouin method, were shown. It is shown how the radial charge distribution in the hydrogen atom varies in an electric field. (JSR)

16776 MAGNETIC INTERACTIONS IN TRANSITION METAL IONS. I. Electronic Configurations d^2, d^3, and d^4. Li, W. K. (Chinese Univ. of Hong Kong, Shatin). At. Data; 2: No. 1, 45-56 (Dec 1970).

The magnetic interaction energy was calculated for various d^2, d^3, and d^4 isoelectronic systems. It is found that the spin-other-orbit interaction is about 4 to 7% of the spin-own-orbit contribution; that of spin-spin interaction is about 10% of the spin-other-orbit energy. Furthermore, the increase of a unit charge on the cation will cause the magnetic interactions to increase by 50 to 60%. The three magnetic interactions account rather well for the energy separations between the states arising from a given configuration. (auth)

16777 POTENTIAL-ENERGY CURVES FOR MOLECULAR HYDROGEN AND ITS IONS. Sharp, T. E. (Lockheed Palo Alto Research Lab., CA). At. Data; 2: No. 2, 119-169(Apr 1971).

Graphs and tables of potential-energy curves for the known states of H_2, H_2^+, and H_2^- are presented. A brief discussion of each state includes citations of the original articles to serve as a key to the extensive literature on hydrogen. Most of the references report work published between 1950 and mid-1970. (Earlier work has been covered by Herzberg.) A correlation diagram and conversion table are included for convenience. In the tables distances are given in angstroms and bohrs, and energies are given in wave numbers, electron volts, and hartrees. In the graphs, energy in electron volts is plotted against internuclear distance in angstroms. Although much is known about molecular hydrogen and its ions, a considerable amount of research remains to be done. This report is an attempt to summarize the present state of knowledge and to indicate some of the work currently in progress. (auth)

16778 EIGENPARAMETERS FOR THE LOWEST TWENTY ELECTRONIC STATES OF THE HYDROGEN MOLECULE ION.

Madsen, M. M.; Peek, J. M. (Sandia Labs., Albuquerque, NM). At. Data; 2: No. 3, 171-204(May 1971).

The electronic Hamiltonian for H_2^+, obtained by assuming the nuclei are infinitely heavy and by including only electrostatic Coulomb terms in the potential, is solved numerically for all states correlating at large internuclear separation to a proton and hydrogen atom with principal quantum number one, two, or three. (auth)

16779 K x-RAY TRANSITION PROBABILITIES. Nelson, G. C. (Univ. of California, Livermore); Saunders, B. G.; Salem, S. I. At. Data; 1: No. 4, 377-384(Nov 1970).

"Best" values for ratios of probabilities of x-ray transitions following a K-shell vacancy were determined by drawing smooth curves through the recent experimental data plotted as functions of atomic number, $20 \leq Z \leq 100$. The probability ratios considered are $K\alpha_2/K\alpha_1$, $K\beta_3/K\beta_1$, $(K\beta_1 + K\beta_3)/K\alpha_1$, $K\beta_1'/K\alpha_1$, $K\beta_2'/K\alpha_1$, and $K\beta/K\alpha$. The results are compared with the values adopted in 1959 by Wapstra et al. and with the recent theoretical calculations of Scofield. (auth)

16780 IONIZATION POTENTIALS, EXPERIMENTAL AND THEORETICAL, OF THE ELEMENTS HYDROGEN TO KRYPTON. Kelly, R. L.; Harrison, D. E. Jr. (Naval Postgraduate School, Monterey, CA). At. Data; 3: No. 2, 177-193(Sep 1971).

The ionization potentials of the first 36 elements are examined as isoelectronic sequences. Hartree-Fock theoretical ionization potentials are modified by adding a correction which is extrapolated from the difference between theory and experiment. If the data are insufficient to develop a plausible extrapolation, the theoretical values are reported together with an estimate of their reliability. (auth)

16781 STATIC DIPOLE POLARIZABILITIES OF ALL THE NEUTRAL ATOMS IN THEIR GROUND STATES. Teachout, R. R.; Pack, R. T. (Brigham Young Univ., Provo, UT). At. Data; 3: No. 2, 195-214(Sep 1971).

Values of the static dipole polarizabilities of all neutral atoms in their ground electronic states were collected and tabulated. A bibliography for both theoretical and experimental determinations is included. (auth)

16782 COMPILATION OF ATOMIC ULTRAVIOLET PHOTOABSORPTION CROSS SECTIONS FOR WAVELENGTHS BETWEEN 3000 AND 10 A. Hudson, R. D. (Manned Spacecraft Center, Houston, TX); Kieffer, L. J. At. Data; 2: No. 3, 205-262(May 1971).

Graphical displays of selected experimental data on atomic photoabsorption cross sections as functions of wavelength are presented for 24 atoms. Criteria used in the data selection are discussed. Reference for all data chosen and an author index are included. The literature was covered through October 1969. (auth)

16783 BIBLIOGRAPHY OF D-SHELL COMPUTATIONAL TOOLS AND CALCULATIONS. Li, W. K. (Chinese Univ. of Hong Kong, Shatin). At. Data; 3: No. 4, 363-368(Dec 1971).

A bibliography of the computational tools and calculations for systems with d^n configurations is presented. The interactions covered are those of Coulomb, orbit-orbit, spin-orbit, spin-other-orbit, and spin-spin Hamiltonians. (auth)

16784 HARTREE-FOCK VALUES OF ENERGIES, INTERACTION CONSTANTS, AND ATOMIC PROPERTIES FOR THE GROUND STATES OF THE NEGATIVE IONS, NEUTRAL ATOMS, AND FIRST FOUR POSITIVE IONS FROM HELIUM TO KRYPTON. Fraga, S.; Sexena, K. M. S.; Lo, B. W. N. (Univ. of Alberta, Edmonton). At. Data; 3: No. 4, 323-361(Dec 1971).

The expressions of the operators and corresponding matrix elements (within the one-electron function approximation) for the various interaction energies and corrections in many-electron atoms were summarized. Numerical values are presented of 19 of these energies, or associated coupling constants, and of various atomic properties—ionization potential, spin-orbit coupling constant, magnetic hyperfine structure constant, dipole polarizability, atomic radius, etc. The calculations were carried out, with analytical Hartree-Fock functions, for the ground states of the negative ions, neutral atoms, and first four positive ions from He to Kr. The predictive value of the results is examined. (auth)

16785 L X-RAY TRANSITION PROBABILITIES. Salem, S. I.; Schultz, C. W. (California State Coll., Long Beach). At. Data; 3: No. 3, 215-226(Nov 1971).

Most probable values of L x-ray transition ratios were determined by drawing smooth curves through the available data points plotted as a function of atomic number. The adapted values are presented in four tables: one for each of the three L-subshells, and a fourth for additional L-transition ratios. Graphic presentation of the experimental points and the results of the calculations based on the relativistic Hartree-Fock-Slater potential are also included. (auth)

16786 SURVEY OF PHOTON-ATTENUATION-COEFFICIENT MEASUREMENTS 10 eV to 100 GeV. Hubbell, J. H. (National Bureau of Standards, Washington, DC). At. Data; 3: No. 3, 241-297(Nov 1971).

A bibliography of 290 references containing measured absolute-value photon total cross section data above 10 eV is presented, covering the period 1909 to June 1971. An index by element (Z = 1 to Z = 94) and energy range, characterizing experiments according to source, detector, and number of data points, is included. Graphs are presented for 17 elements (Z = 1 to Z = 92) over the energy range 100 eV to 10 MeV comparing some recent attenuation-coefficient tabulations [by the Lawrence Radiation Laboratory (Livermore), National Bureau of Standards, Los Alamos Scientific Laboratory, and others] with the above documented data points. (auth)

16787 BAND OSCILLATOR STRENGTHS AND TRANSITION PROBABILITIES FOR THE LYMAN AND WERNER SYSTEMS OF H_2, HD, AND D_2. Allison, A. C.; Dalgarno, A. (Harvard Coll. Observatory, Cambridge, MA). At. Data; 1: No. 3, 289-304(May 1970).

The electronic dipole-moment functions of Wolniewicz are used in calculations of the band oscillator strengths and transition probabilities for the individual bands of the Lyman ($B^1\Sigma_u^+ - X^1\Sigma_g^+$) and Werner ($C^1\Pi_u - X^1\Sigma_g^+$) systems of H_2 and of its isotopes HD and D_2. (auth)

16788 STARK SHIFTS OF He I 3889, He I 4713, AND He I 5016. Morris, R. N.; Cooper, J. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 51: No. 16, 1746-1751(15 Aug 1973).

The shifts of the means of three isolated neutral helium plasma spectral lines emitted from an atmospheric plasma jet ($T_e \simeq 15{,}000°K$ and $ne \simeq 10^{16}$ cm^{-3}) were measured. Using the GBKO Stark broadening theory, first with the quasi-static assumption for the ions and then taking ion dynamic effects into account, formulas were derived and used to determine theoretically predicted shifts to be compared with the measured values under the experimental conditions. The agreement is good, and only small deviations from quasi-static behavior occurred. (auth)

16789 ENERGY OF THE WKα_1 X RAYS. Beer, W.; Kern, J. (Univ. of Fribourg, Switzerland). Phys. Lett.; 47B: No. 4, 345-347(26 Nov 1973).

It is shown that the WKα_1 X-rays emitted after the ^{182}Ta β-decay are shifted by 1.8 ± 0.5 eV relative to "normal" W X-rays. This effect is explained by a chemical shift. (auth)

16790 EFFECT OF ERROR IN THE UNPERTURBED WAVE FUNCTION ON ELECTRIC POLARIZABILITIES AND SHIELDING FACTORS OF ATOMS. Kaneko, S. (Tokyo Univ.); Inokuti, M. Chem. Phys. Lett.; 23: No. 2, 275-277(15 Nov 1973).

The polarizability and the shielding factor of the hydrogen atom are calculated by using an unperturbed wave function Φ_0 with one parameter. The accuracy of Φ_0 is changed by varying the parameter. The polarizability is sensitive to the error in Φ_0, but the shielding factor is less sensitive. (auth)

16791 INTERACTION POTENTIAL FOR He/H_2 INCLUDING THE REGION OF THE VAN der WAALS MINIMUM. Tsapline, B.; Kutzelnigg, W. (Institut fuer Physikalische, Karlsruhe, Ger.). Chem. Phys. Lett.; 23: No. 2, 173-177(15 Nov 1973).

The energy of He/H_2 in its ground state is calculated in an ab-initio way using the IEPA PNO method for three different H-H distances, three different angles and for distances between He and the midpoint of H_2 ranging from 3 to 20 α_0. A van der Waals minimum of $\approx 21°K$ is found for the linear arrangement and a saddle point of $\approx 14°K$ for the C_{2v} geometry. The computed hypersurface is compared with experiment and with the R^{-6} term known from perturbation theory. The anisotropy of the potential is much larger than what is predicted asymptotically. (auth)

16792 MULTI-CONFIGURATION HARTREE-FOCK CORRELATION STUDY OF 1s2s ^{1}S. Fischer, C. F. (Univ. of Waterloo, Ont.). Can. J. Phys.; 51: No. 11, 1238-1243(1 Jun 1973).

A correlation study is performed for the 1s2s ^{1}S state of helium to neon. It is shown that the Hartree-Fock approximation is poor, and that the two-configuration approximation $\Phi = a_1|1s2s\rangle + a_2|1s^2\rangle$ is equivalent to a nonorthogonal Hartree-Fock approximation for which Koopmans' theorem holds. Additional configurations are introduced which account for 90% of the correlation energy. (auth)

16793 AUTOIONIZATION AND ELECTRONIC CORRELATION IN ATOMS. Mayers, D. F. (Oxford Univ.); Rebelo, I.; Sharma, C. S. Can. J. Phys.; 51: No. 16, 1701-1704(15 Aug 1973).

By considering the particular case of the $2s^2$ ^{1}S state of helium,

it is shown that in the Hartree–Fock approximation autoionizing states of atoms have square-integrable wave functions and are, therefore, bound states. It follows that autoionization is a correlation effect. The autoionizing states must have non-square-integrable wave functions. The origin of the breakdown of the square integrability is studied with the help of a spectral analysis of the first-order wave function. (auth)

16794 ELECTRONIC SPECTRUM OF THE LuH MOLECULE. Effantin, C.; D'Incan, J. (Univ., Lyon). Can. J. Phys.; 51: No. 13, 1394-1402(1 Jul 1973). (In French).

Six new electronic band systems, assigned to LuH, were excited between 5000 and 8000 Å in a Lu_2O_3–Th–Cu hollow cathode filled with argon and traces of hydrogen. The molecular constants and the nature of the electronic states of this molecule are derived from their rotational analysis. (auth)

16795 HEXADECAPOLE MOMENT OF THE HYDROGEN MOLECULE. Karl, G.; Obryk, E.; Poll, J. D. (Univ. of Guelph, Ont.). Can. J. Phys.; 51: No. 20, 2216-2217(15 Oct 1973).

The $\Delta v = 0$, 1 matrix elements of the hexadecapole moment of the hydrogen molecule are estimated to be $0.10ea_0^4$ and $0.034ea_0^4$ respectively. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 16914, 16974, and 17335.

16796 (COO-3373-11) BROMINE AND OXYGEN QUENCHING OF POSITRONIUM IN SILICA GEL. Chuang, S. Y.; Tao, S. J. (New England Inst., Inc., Ridgefield, Conn. (USA)). 1974. Contract AT(11-1)-3373. 22p. (CONF-730850-1). Dep. NTIS $3.25.

From third international conference on positron annihilation; Otaniemi, Finland (Aug 1973).

Positron lifetime spectra for various concentrations of bromine and oxygen adsorbed on silica gel are investigated. Two-photon angular correlation experiments are also performed on some of these samples to investigate the quenching process of bromine and oxygen. The cross section for bromine quenching of ortho-positronium in silica gel is about two orders of magnitude larger than that for oxygen quenching. The process of bromine quenching of positronium is found to be chemical quenching. Oxygen quenching of positronium in silica gel is found to be conversion quenching. The interaction between positronium and bromine or oxygen in silica gel is found to be similar to that found in the gaseous state. The energy of Ps annihilating in the pores of silica gels is found to be 0.25 ± 0.10eV. (auth)

16797 (COO-3373-12) POSITRONIUM IN MOLECULAR SUBSTANCES. Tao, S. J. (New England Inst., Inc., Ridgefield, Conn. (USA)). 1973. Contract AT(11-1)-3373. 25p. (CONF-730850-2). Dep. NTIS $3.25.

From third international conference on positron annihilation; Otaniemi, Finland (Aug 1973).

The progress of research in the behavior of positronium in molecular substances in the last several years is reviewed. The Ps atom can be treated as a solute in a liquid and the repulsive exchange force is the dominant force which reacts against the van der Waals attractive force. One of the most useful general relations found is the one between the pick-off quenching rate and the surface tension of the liquid. The pick-off quenching rate is found, in general, to be an additive property of the functional groups of a molecule. The quenching of the o-Ps atom by an active quenching agent in an inert solvent was found to be primarily diffusion controlled. Some deviations from the simple Arrhenius equation were found. For gases, more theoretical work on the collision problems of Ps with atoms or molecules is needed. For amorphous molecular solids, it is likely that the property of pick-off quenching of o-Ps is similar to that in liquids. However, in crystalline molecular solids, the situation is quite different. A few definite cases were found where a Ps atom does not form or exist. Further work in this area should be very interesting. The foregoing leads one to believe that positronium or positron annihilation can be useful in the study of fundamental properties of molecular liquids and solids. (auth)

16798 THREE-PHOTON ANNIHILATION OF ORTHO-POSITRONIUM IN ARGON GAS. Bird, H. M. B.; Jones, G. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 51: No. 5, 537-548 (1 Mar 1973).

Marked deviations from simple exponential decay are known to characterize the two-photon annihilation of positrons in the noble gases. In this experiment, a quadruple coincidence system was used to examine the detailed shape of three-photon positron lifetime spectra in argon. No deviation from a simple exponential was observed over the density range 2.57 to 33 amagat, except when a high electric field was applied. The ability to distinguish three-photon ortho-positronium annihilation from other modes of positron annihilation permitted, for the first time, a detailed investigation of the density dependence of the annihilation of ortho-positronium in a simple monatomic gas. Over the whole density range, the ortho-positronium annihilation rate was found to depend linearly on density, with a value of $7.15 \pm 0.10\ \mu s^{-1}$ for the vacuum rate of ortho-positronium annihilation and $0.250 \pm 0.015\ \mu s^{-1}$ amagat^{-1} for the quenching rate of positronium in argon. With a field of 125 V cm^{-1} amagat^{-1} (at 2.57 amagat), a deviation from simple exponential decay was observed, a deviation whose shape is shown to be consistent with an interpretation in terms of time-delayed enhanced positronium production from the equilibrium free positron population. (auth)

16799 POSITRONIUM CHEMISTRY. Brown, B. J. (Univ. of New South Wales, Kensington, Australia). At. Energy Aust.; 16: No. 3, 2-6(Jul 1973).

A description is given of the characteristics of electron/positron behavior and the effects of positrons in relation to the physical and chemical properties of materials. The three most widely used methods to study positron behavior are: three-photon annihilation rate measurement, two-photon angular correlation measurement, positron lifetime measurement. Processes which shorten the lifespan of ortho-Ps are discussed. Annihilation characteristics of positrons in gases, liquids, and polymers are described. It is concluded that positron annihilation techniques can provide valuable information on the physical and chemical properties of materials. (RL)

16800 RECOIL CORRECTIONS TO MUONIC ATOM ENERGY LEVELS. Barrett, R. C. (Univ. of Surrey, Guildford, Eng.); Owen, D. A.; Calmet, J.; Grotch, H. Phys. Lett., 47B: No. 4, 297-299(26 Nov 1973).

The relativistic correction due to nuclear recoil is calcuated for a distributed nuclear charge using the effective potential model of Grotch and Yennie. For the lowest states the results differ substantially from the well known point nucleus values and disagree somewhat with the recent calculation of Fricke. (auth)

16801 NEW EXPERIMENTAL METHOD ALLOWING A QUANTITATIVE MEASURE OF ORTHOPOSITRONIUM MAGNETIC QUENCHING. Falciglia, F.; Inci, G.; Lo Savio, M.; Turrisi, E. (Univ., Catania, Italy). Can. J. Phys.; 51: No. 21, 2270-2274(1 Nov 1973).

A new method for determining the amount of magnetic quenching of the orthopositronium atom is described. This method, still using angular correlation techniques, allows a direct measure of the quantities which the orthopositronium magnetic quenching deals with. By this way, an experimental measurement was performed, as a check, in water at temperature T = 20°C and with a magnetic field H = 10 kG. The obtained value $\Delta I_s = (1.73 \pm 0.22)\%$ is in very good agreement with the theoretical one. (auth)

16802 NOVEL APPROACH TO STUDY ANGULAR CORRELATION OF POSITRON ANNIHILATION RADIATION. Singru, R. M. (Reactor Centrum Nederland, Petten). Phys. Lett.; 46A: No. 1, 61-62(19 Nov 1973).

The Doppler broadening of positron annihilation radiation employing a collinear point slit geometry and coincidence counting was studied, and it provides a new method for the determination of three components of the photon pair momentum. The results for a copper single crystal are compared with theoretical calculations. (auth)

Collision Phenomena

Refer also to abstracts 15794 and 17205.

16803 (BUP-55) INNER SHELL COULOMB IONIZATION BY HEAVY CHARGED PROJECTILES. Hansteen, J. M. (Bergen Univ. (Norway). Dept. of Physics). Aug 1973. 23p. (CONF-730672-1). Dep. NTIS (U. S. Sales Only) $3.25.

From conference on special problems of heavy ion research; Darmstadt, F. R. Germany (19 Jun 1973).

The phenomenon of inner shell atomic Coulomb excitation by heavy charged projectiles has recently received renewed attention. Basic points from the SCA theory are presented and selected results from the simple SCA model are followed by remarks on Pauli excitations. Multiple Coulomb ionizations are discussed and results, without taking Auger processes into account, are tabulated for $H^+ \rightarrow$ argon, copper, silver and tin, and for $F_9 \rightarrow$ tin. The limits of the simple SCA model are considered and finally it is stated that this branch of collision physics has probably

reached a turning point and that the PSS approach appears promising. (JIW)

16804 (COO-2092-27) DYNAMICS OF CHEMICAL REACTIONS. Progress Report, January 1, 1973–December 31, 1973. Lee, Y. T. (Chicago Univ., Ill. (USA)). 1973. Contract AT(11-1)-2092. 14p. Dep. NTIS $3.00.

In this period, significant progress has been made in the studies of: interactions and reactions of metastable rare gas atoms, and atoms and molecules; the dynamics of collision induced dissociation of diatomic molecules; translational to vibrational rotational energy transfers of linear triatomic molecules by rare gas atoms; scattering of state selected molecules; improvement in the velocity analysis of scattered molecules and the method of atomic beams production; and intramolecular energy transfers and unimolecular decomposition. (auth)

16805 ELASTIC SCATTERING OF 100 MeV PROTONS BY ^{14}N. Chao, C. C.; Lee, J. K. P. (McGill Univ., Montreal). Can. J. Phys.; 51: No. 5, 592-594(1 Mar 1973).

The elastic scattering of 100 MeV protons from ^{14}N was studied, and results were analyzed by the optical model. The optical potential parameters obtained were compared to those from the same reaction at different bombarding energies and also to those obtained from elastic scattering data of 100 MeV protons from other 1p shell nuclei. (auth)

16806 LONG RANGE COLLISION-INDUCED DIPOLES. Abdulnur, S. F. (Univ. of Florida, Gainesville). Chem. Phys. Lett.; 23: No. 3, 355-358(1 Dec 1973).

A method for estimating the long range dipole moment coefficient, D_1, for two colliding dissimilar S-state atoms from their ground state sum rule values is presented and applied to systems involving H, He and Ne. (auth)

16807 EXACT QUANTUM MECHANICAL REACTION PROBABILITIES FOR THE COLLINEAR H + H_2 REACTION ON A PORTER–KARPLUS POTENTIAL ENERGY SURFACE. Duff, J. W.; Truhlar, D. G. (Univ. of Minnesota, Minneapolis). Chem. Phys. Lett.; 23: No. 3, 327-330(1 Dec 1973).

Exact quantum mechanical calculations of the reaction probability for the collinear H + H_2 reaction on a Porter–Karplus potential energy surface are carried out by the finite-difference boundary value method at 6 energies in the threshold region and compared to close coupling, distorted wave, classical S matrix, transition state theory, and vibrational adiabatic calculations. (auth)

16808 MEASUREMENTS OF THE m_J-DEPENDENT COLLISION CROSS SECTION OF H_2 MOLECULES WITH VARIOUS GASES. Moerkerken, H. C. H. A.; Zandee, A. P. L. M.; Reuss, J. (Catholic Univ., Nymegen, Netherlands). Chem. Phys. Lett.; 23: No. 3, 320-321(1 Dec 1973).

Relative total cross sections were measured for the systems H_2–Xe, Kr, Ar and CO_2 with velocities between 1200 and 1850 m/sec. The H_2 molecules were selected in the states (I, J, m_I, m_J) = (1, 1, 1, 0) and (1, 1, 1, 1). The ratio of the cross sections for the two states is a measure for the angular dependent part of the intermolecular potential. No satisfying fit of potential parameters was found so far. (auth)

16809 SMALL ANGLE SCATTERING OF ELECTRONS. Rausaria, R. R.; Singhal, R. P.; Singh, R. N. (Banaras Hindu Univ., Varanasi, India). Phys. Lett.; 46A: No. 2, 85-86(3 Dec 1973).

The small angle scattering of low energy electrons was studied. It was shown that the cross sections obtained using the Born's first approximation, corrected for screening effects should be used to study the small angle scattering of low energy electrons. (auth)

16810 INELASTIC SCATTERING OF HIGH ENERGY ELECTRONS BY HELIUM. Ojha, S. P.; Tiwari, P.; Rai, D. K. (Banaras Hindu Univ., India). Can. J. Phys.; 51: No. 3, 311-315 (1 Feb 1973).

Generalized oscillator strengths and the cross section for excitation of helium by electron impact were calculated in the Born approximation. Transitions from the ground state to the n^1P (n = 2 and 3) states were considered. Highly accurate wave functions of the Hartree–Fock and "configuration-interaction" type were used to represent the ground state. Approximate wave functions due to Messmer were employed for the final states. The results are compared with other calculations and with experiment. (auth)

16811 SENSITIZED FLUORESCENCE IN SODIUM INDUCED IN COLLISIONS WITH $Hg(6^3P_1)$ ATOMS. Czajkowski, M.; Skardis, G.; Krause, L. (Univ. of Windsor, Ont.). Can. J. Phys.; 51: No. 3, 334-342(1 Feb 1973).

Collisional transfer of excitation from mercury to sodium was investigated using methods of sensitized fluorescence. A mixture of mercury and sodium vapors at low pressure was irradiated with Hg 2537 Å resonance radiation, producing a population of $Hg(6^3P_1)$ atoms whose inelastic collisions with ground-state sodium atoms resulted in a transfer of excitation energy to close-lying S, P, and D states in sodium. The subsequent decay of these states manifested itself in the emission of a sensitized fluorescent spectrum. Absolute intensity measurements on the components of the spectrum yielded 21 cross sections whose magnitudes range from 0.02 to 38.5 $Å^2$ and which exhibit a pronounced resonance with ΔE, the energy defect between $Hg(6^3P_1)$ and the appropriate level in sodium. (auth)

16812 INELASTIC COLLISIONS BETWEEN EXCITED ALKALI ATOMS AND MOLECULES. VIII. $6^2P_{\frac{3}{2}}$–$6^2P_{\frac{1}{2}}$ Mixing and Quenching in Mixtures of Rubidium with H_2, HD, D_2, N_2, CH_4, and CD_4. Siara, I. N.; Krause, L. (Univ. of Windsor, Ont.). Can. J. Phys.; 51: No. 3, 257-265(1 Feb 1973).

Excitation transfer between the 6^2P fine-structure substates in rubidium, induced in inelastic collisions with ground-state molecules, was studied using techniques of sensitized fluorescence. Rubidium vapor in mixtures with various molecular gases was irradiated with each component of the ^2P rubidium doublet in turn, and measurements of sensitized-to-resonance fluorescent intensity ratios yielded the following mixing cross sections $Q_{12}(^2P_{\frac{3}{2}} \rightarrow {}^2P_{\frac{1}{2}})$ and $Q_{21}(^2P_{\frac{3}{2}} \leftarrow {}^2P_{\frac{1}{2}})$, as well as effective quenching cross sections $Q_{1X}(^2P_{\frac{3}{2}} \rightarrow {}^2X_{J''})$ and $Q_{2X}(^2P_{\frac{1}{2}} \rightarrow {}^2X_{J''})$. For collisions with H_2: $Q_{12}(^2P_{\frac{3}{2}} \rightarrow {}^2P_{\frac{1}{2}}) = (41 \pm 5)$ $Å^2$; $Q_{21}(^2P_{\frac{3}{2}} \leftarrow {}^2P_{\frac{1}{2}}) = (26 \pm 3)$ $Å^2$; $Q_{1X}(^2P_{\frac{3}{2}} \rightarrow {}^2X_{J''}) = (36 \pm 9)$ $Å^2$; $Q_{2X}(^2P_{\frac{1}{2}} \rightarrow {}^2X_{J''}) = (31 \pm 8)$ $Å^2$. For HD: $Q_{12} = (42 \pm 5)$ $Å^2$; $Q_{21} = (27 \pm 4)$ $Å^2$; $Q_{1X} = (47 \pm 13)$ $Å^2$; $Q_{2X} = (38 \pm 10)$ $Å^2$. For D_2: $Q_{12} = (42 \pm 5)$ $Å^2$; $Q_{21} = (27 \pm 4)$ $Å^2$; $Q_{1X} = (28 \pm 8)$ $Å^2$; $Q_{2X} = (21 \pm 7)$ $Å^2$. For N_2: $Q_{12} = (107 \pm 15)$ $Å^2$; $Q_{21} = (70 \pm 10)$ $Å^2$; $Q_{1X} = (128 \pm 44)$ $Å^2$; $Q_{2X} = (126 \pm 33)$ $Å^2$. For CH_4: $Q_{12} = (38 \pm 6)$ $Å^2$; $Q_{21} = (24 \pm 3)$ $Å^2$; $Q_{1X} = (129 \pm 41)$ $Å^2$; $Q_{2X} = (114 \pm 37)$ $Å^2$. For CD_4: $Q_{12} = (52 \pm 7)$ $Å^2$; $Q_{21} = (34 \pm 5)$ $Å^2$; $Q_{1X} = (82 \pm 30)$ $Å^2$; $Q_{2X} = (76 \pm 22)$ $Å^2$. An analysis of these results suggests the possibility of resonances with various molecular rotational and vibrational transitions. (auth)

16813 IONIZATION OF LIQUID XENON AND ARGON BY ALPHA-PARTICLES. Konno, S. (Inst. of Physical and Chemical Research, Wako, Japan); Kobayashi, S. Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 67: No. 2, 57-62(Jun 1973).

The average energy to produce an ion pair, the W-value, in liquid xenon irradiated with α-particles emitted from ^{210}Po is evaluated from the ratio of electron pulse heights in liquid xenon to those in argon, assuming that the Jaffé's columnar theory of ionization is valid. The W-value in liquid xenon is found to be 17.3 eV, which is lower than that in the gaseous phase. Also, the ratio of the recombination coefficient for electrons and xenon ions to the diffusion coefficient in liquid xenon and the ratio of the recombination coefficient for electrons and argon ions to the mobility of electrons in liquid argon are estimated to be 2.7×10^6 cm and 4.8×10^{-8} V cm, respectively. (auth)

16814 VELOCITY DEPENDENCE OF DOUBLE INNER-SHELL IONIZATION IN VANADIUM BY PROTON AND α-PARTICLE IMPACT. Cue, N.; Dutkiewicz, V.; Sen, P.; Bakhru, H. (State Univ. of New York, Albany). Phys. Lett.; 46A: No. 2, 151-152(3 Dec 1973).

Ratios of double (KL) to single (K) ionization cross sections for proton and α-particle impact on vanadium are measured with velocities V = 0.53 to 1.7 (in units relative to the L-shell electron velocity) and are found to be reproduced by the recipe of McGuire and Richard. (auth)

16815 COHERENCE TRANSFER BETWEEN THE $^2P_{\frac{3}{2}}$ AND $^2P_{\frac{1}{2}}$ STATES IN POTASSIUM, INDUCED IN COLLISIONS WITH NOBLE GAS ATOMS AND WITH MOLECULES. Niewitecka, B.; Krause, L. (Univ. of Windsor, Ont.). Can. J. Phys.; 51: No. 4, 425-430(15 Feb 1973).

The transfer of coherence accompanying $4^2P_{\frac{3}{2}} \rightarrow 4^2P_{\frac{1}{2}}$ transfer of excitation induced in collisions between $4^2P_{\frac{3}{2}}$ potassium atoms and noble gas atoms as well as some simple molecules, was studied in a series of sensitized fluorescence experiments. Mixtures of potassium vapor at 6×10^{-7} torr with the various buffer gases were irradiated with circularly polarized $D_1(\sigma^+)$ light and the relative intensities of the σ^+ and σ^- fractions of both the D_1 and D_2 fluorescent components were determined in relation to the pressures of the buffer gases. The experiments yielded the following cross sections for coherence transfer: K–He: 1.7 $Å^2$; K–Ne: 0.8 $Å^2$; K–Ar < 0.5 $Å^2$; K–H_2: 3.5 $Å^2$; K–CH_4: 7.0 $Å^2$; K–CD_4: 7.7 $Å^2$. (auth)

16816 RESONANT ROTATIONAL EXCITATION OF H_2 BY ELECTRON IMPACT. Joyez, G. (Laboratoire de Physique et Optique Corpusculaires, Paris); Comer, J.; Read, F. H. J. Phys., B (London); 6: No. 11, 2427-2440(Nov 1973).

By using an electron impact spectrometer with a greatly im-

proved energy resolution it was possible to study the appearance of H_2^- resonances in the energy range 11.0 to 12.25 eV in reactions which lead to specific rotational-vibrational states of the final H_2 molecule. Rotational excitations having $\Delta J = -2$ (i.e., $2 \rightarrow 0$, $3 \rightarrow 1$), $\Delta J = 0$ (i.e., $0 \rightarrow 0$, $1 \rightarrow 1$, $2 \rightarrow 2$, etc.), $\Delta J = +2$ (i.e., $1 \rightarrow 3$, $3 \rightarrow 5$), and $\Delta J = +4$ (i.e., $1 \rightarrow 5$), accompanied by vibrational excitations $\Delta v = 0$, 1, 2, 4, 6 and 8 were studied. Two series of resonances (series a and c) were seen, and their symmetry classifications were established as $^2\Sigma_g^+$ and $^2\Pi_u$ respectively. (auth)

16817 RECOIL EFFECTS IN C–K X RAY PRODUCTION BY 60 TO 250 keV COPPER ION BOMBARDMENT OF GRAPHITE. Marwick, A. D. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Phys., B (London); 6: No. 11, 2445-2449(Nov 1973).

The cross section for C–K x ray production in the bombardment of graphite by copper ions is reported and found to be much larger than the C–K cross section in carbon ion bombardment of copper. The difference is ascribed to C–K production by recoiling carbon atoms, and a calculation of this contribution to the cross section according to the expression of Taulbjerg and Sigmund (Phys. Rev.; A5: 1285-1289(1972)) gives reasonable agreement with the data. (auth)

16818 SCANDIUM Kα AND Kβ DIAGRAM, SATELLITE AND HYPERSATELLITE X RAYS. Hodge, B.; Kauffman, R.; Moore, C. F.; Richard, P. (Univ. of Texas, Austin). J. Phys., B (London); 6: No. 11, 2468-2472(Nov 1973).

X ray transitions from scandium due to proton, helium, and oxygen bombardment are reported. The oxygen + Sc spectrum displays the largest number of satellites including three hypersatellite transitions, and in the He + Sc spectrum double electron transitions were observed. Hartree–Fock–Slater calculated energies were used to assign the transitions. (auth)

16819 SCATTERING OF LOW ENERGY POSITRONS BY HELIUM. Humberston, J. W. (Goddard Space Flight Center, Greenbelt, MD). J. Phys., B (London); 6: No. 11, L305-L308(Nov 1973).

Kohn's variational method is used to calculate the positron-helium scattering length and low-energy S-wave phase shifts for a quite realistic Hylleraas type of helium function containing an electron-electron correlation term. The zero energy wave function is used to calculate the value of the annihilation rate parameter Z_{eff}. All the results are significantly different from those for Drachman's helium model B (J. Phys. B, Atom. Molec. Phys.; 5: L30-L32(1972)), but are in better agreement with the available experimental data. (auth)

16820 COMPARISON OF ELECTRON EMISSION CROSS SECTIONS FROM AUTOIONIZING STATES OF HELIUM BY ELECTRON IMPACT AND H^+, H_2^+ AND He IMPACTS. Oda, N.; Tahira, S.; Nishimura, F. (Tokyo Inst. of Tech.). J. Phys., B (London); 6: No. 11, L309-L311(Nov 1973).

A comparison was made of the experimental electron emission cross sections from autoionizing states of helium for electrons, H^+, H_2^+, and He incident at the same velocity of relative motion on helium in the backward ejection angles. While emission cross sections from the singlet states, $(2s^2)^1S$, $(2p^2)^1D$, and $(2s2p)^1P$, have broad maxima in 100 to 200 eV region for electron impact, the maxima for the other projectile impacts appear in the energy region corresponding to much slower velocities. The emission cross section from the $(2s2p)^3P$ state excited by electrons is of quite different feature as compared with those by the other projectiles. (auth)

16821 COMBINED THEORY OF CLASSICAL EXCITATION OF ATOMS BY CHARGED PARTICLES. Percival, I. C. (Univ. of Colorado, Boulder). J. Phys., B (London); 6: No. 11, 2236-2263(Nov 1973).

A "combined" analytic theory of classical excitation of hydrogenic atoms and ions by charged particles is presented: it is valid for all energy transfers at sufficiently high incident particle velocity. The theory reduces to the binary encounter or classical impulse approximation and to an adiabatic dipole perturbation theory in their respective ranges of validity. The combined theory agrees reasonably well with published Monte Carlo trajectory calculations. It is confirmed that adiabatic effects are a major defect of binary encounter theory. The energy transfer distribution for fixed impact parameter is studied. (auth)

16822 POLARIZATION EFFECT IN MULTIPHOTON IONIZATION OF HYDROGEN FROM METASTABLE 2S STATE. Choudhury, B. J. (Univ. of Manitoba, Winnepeg). J. Phys., B (London); 6: No. 11, 2268-2270(Nov 1973).

A general analytical result was obtained for multiphoton ionization of hydrogen from metastable 2S state. Numerical results are given for the ratio of cross sections of ionization by linearly polarized and circularly polarized light for N = 2, 3, 4 (where N is the number of photons absorbed). In all these cases the cross section for linearly polarized light dominates over the cross section for circularly polarized light. (auth)

16823 PHOTOIONIZATION OF THE 2^1S AND 2^3S STATES OF HELIUM. Bell, K. L.; Kingston, A. E.; Taylor, I. R. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 11, 2271-2279(Nov 1973).

The continuous oscillator strengths for photoionization of the 2^1S and 2^3S states of helium are evaluated in the dipole length and velocity formulations for transitions which leave the He^+ ion in a 1s, 2s or 2p state. The calculations are performed with two sets of wave functions: Calculation A uses frozen core Hartree–Fock bound and free state functions; Calculation B uses a 56-parameter bound state representation with frozen core Hartree–Fock free state functions. Where possible the results are compared with the more accurate values of Jacobs and Burke (J. Phys. B, Atom. Molec. Phys.; 5: 2272-81 (1972)). (auth)

16824 SCATTERING OF ELECTRONS BY HYDROGEN AND HELIUM ATOMS USING THE EIKONAL APPROXIMATION. Saha, B. C.; Sarkar, K.; Ghosh, A. S. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 6: No. 11, 2303-2305(Nov 1973).

The eikonal approximation was used to investigate the elastic scattering of electrons by hydrogen and helium atoms. Results obtained for the differential cross sections for both the systems are compared with the experimental findings and also with the corresponding results obtained by other theoretical workers. (auth)

16825 COLLISIONS BETWEEN ELECTRONS AND H_2^+ IONS. IV. Measurements of Cross Sections for Dissociative Ionization. Peart, B.; Dolder, K. T. (Newcastle upon Tyne Univ., Eng.). J. Phys., B (London); 6: No. 11, 2409-2414(Nov 1973).

Cross sections for the dissociative ionization of H_2^+ by electron impact were measured for interaction energies below 940 eV. A source was used which produced H_2^+ ions under clearly defined conditions. The cross section attained a maximum value of $0.2\pi a_0^2$ at 103 eV which is in fairly good agreement with classical predictions by Alsmiller (ORNL-2766 (1962)) and Mathur et al. (Phys. Rev. A; 1: 1404-6(1970)). A Bethe plot of the results rolls over in a way which suggests that the Bethe approximation will only be valid for this reaction for energies of at least several hundred eV. (auth)

16826 THEORY OF THE (e,2e) REACTION ON MOLECULES. McCarthy, I. E. (Flinders Univ. of South Australia). J. Phys., B (London); 6: No. 11, 2358-2367(Nov 1973).

A general formula is given for the cross section for the (e,2e) reaction on molecules in terms of a multicenter model for the SCF orbitals. Rotations and vibrations are taken into account. For the cases of homonuclear diatomic molecules and methane it is shown how symmetries reduce the computational labor to the point where it is possible to use the reaction as a simple test of the details of the SCF orbitals. The details of a calculation for H_2 involving rotational excitations are given. (auth)

16827 EXCITATION CROSS SECTIONS FOR $e^- - N_2$ SCATTERING. Chandra, N.; Burke, P. G. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 11, 2355-2357(Nov 1973).

The rotational excitation cross sections for $e^- - N_2$ scattering for incident electron energies for 0.2 to 10.0 eV are calculated. Initial rotational levels up to 20 are considered. (auth)

16828 DOUBLE EXCITATION OF HELIUM BY ELECTRON IMPACT. Gillespie, E. S. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 11, 2321-2324(Nov 1973).

Cross sections for the electronic excitation of the $(ns,mp)^1P$ states (for n,m = 2,3,4) from the ground state are calculated using the Born approximation and multi-parameter Hylleraas-type wave functions. The influence of the interelectron coordinate r_{12} is discussed. (auth)

16829 SECONDARY ELECTRON EMISSION AS A TECHNIQUE FOR IN SITU CRYSTAL ALIGNMENT IN LOW ION-ENERGY REFLECTION EXPERIMENTS. Feijen, H. H. W.; Verhey, L. K.; Boers, A. L.; Suurmeijen, E. P. T. M. (Univ., Groningen, Netherlands). J. Phys., E (London); 6: No. 12, 1174-1175(Dec 1973).

The secondary electron yield due to the bombardment of a copper (001) crystal with 7-keV H_2^+ ions was measured as a function of the target spatial position. From these spectra the orientation of the crystal could be determined within 0.2°. (auth)

16830 CALCULATION OF CROSS SECTIONS FOR ELECTRON SCATTERING BY ALKALINE EARTH ATOMS IN BORN AND STATIC APPROXIMATION. Fabrikant, I. I. (Inst. of Physics,

Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 5, 3-6(1973). (In Russian).

The cross sections for the elastic scattering of slow electrons are considered. The results of static approximation for Mg are compared with data obtained by the method of close coupling calculation. (auth)

16831 VARIATIONAL CONTINUUM DISTORTED WAVE APPROXIMATION. Proton–Hydrogen Charge Transfer at Very High Energies. Shakeshaft, R. (New York Univ.). J. Phys., B (London); 6: No. 11, 2315-2320(Nov 1973).

A variational form of the continuum distorted wave approximation is used to provide further evidence that the second Born term dominates in the high energy limit of proton–hydrogen forward charge transfer. (auth)

16832 MEASUREMENT OF CROSS SECTIONS FOR THE 1S–2S EXCITATION OF He^+ IONS BY ELECTRON IMPACT. Dolder, K. T.; Peart, B. (Newcastle Upon Tyne Univ., Eng.). J. Phys., B (London); 6: No. 11, 2415-2426(Nov 1973).

A crossed beam experiment was performed to measure the function for 1S–2S excitation of He^+ ions by electron impact. Absolute cross sections for direct excitations to the 2S state were deduced by fitting the measurements to Born's approximation at high energies, after allowance was made for the contribution from cascade. Just above threshold the cross section was $1.28 \times 10^{-2}\ \pi a_0^2$, which agrees closely with the previous measurement by Dance et al (Proc. R. Soc.; A290: 74-93 (1966)), but it is less than half the threshold cross section predicted by the close-coupling calculation of Burke et al (Proc. Phys. Soc.; 83: 397-407 (1964)). There is, however, much better agreement with the recent distorted wave polarized orbital calculation by McDowell et al (J. Phys. B. Atom. Molec. Phys.; 6: 1441-57 (1973)). The present measurement was free from any evidence of error due to space charge interactions between the colliding beams and it was possible to examine structure in the excitation function associated with the formation of autoionizing states of helium. (auth)

16833 INCOHERENT SCATTERING OF γ RAYS IN C, Al, Cu, Sn, AND Pb. Gopal, S.; Sanjeevaiah, B. (Mysore Univ., India). J. Phys., B (London); 6: No. 11, 2441-2444(Nov 1973).

The total atomic cross sections are determined in carbon, aluminum, copper, tin and lead at γ ray energies of 84, 129, 145.41 279.12, 322, 411.8 and 661.6 keV by a new method reported by the authors earlier (Gopal and Sanjeevaiah. Nucl. Instrum. Meth.; 107: 221-5 (1973)). The values of bound electron incoherent scattering cross sections σ_b are extracted from the total atomic cross sections by subtracting the theoretical sum of photoelectric and Rayleigh scattering cross sections. The σ_b values are compared with the corresponding values of σ_{KN}, σ_{TF} and σ_{HF} calculated on the basis of Klein–Nishina (KN) formula, Thomas–Fermi (TF) model and Hartree–Fock (HF) model respectively. The discrepancy between σ_b and σ_{KN} worsens as the photon energy decreases and the atomic number increases, thereby indicating the increasing importance of the binding energy effects. Discrepancies with σ_{TF} and σ_{HF} show similar behavior. These are attributed to limitations inherent in the TF and HF models. (auth)

16834 THREE-BODY ANALYSIS OF ELECTRON-HYDROGEN ATOM COLLISIONS. Gryzinski, M. (Inst. of Nuclear Research, Warsaw); Kunc, J.; Zgorzelski, M. J. Phys., B (London); 6: No. 11, 2292-2302(Nov 1973).

Electron-hydrogen atom inelastic collisions were studied as a three-body classical interaction process. The approach employed in this work differs from the previous study of the same problem of Abrines et al (Proc. Phys. Soc.; 89: 515-23 (1966)) in that a different classical model of the undisturbed ground state hydrogen atom was employed and a systematic investigation of the cross sections was performed in place of a Monte-Carlo method. The basic feature of the model atom employed is its zero angular momentum due to the assumption of the radial motion of the atomic electron ("free-fall" trajectory). The results are compared with experiment, yielding better agreement at low energies than that obtained by Abrines et al. Some comparisons of the three-body results with the binary-encounter approximation are also given. (auth)

16835 CLOSE COUPLING CALCULATIONS FOR MASSIVE ION-HYDROGEN ATOM COLLISIONS IN THE LINEAR TRAJECTORY MODEL. Msezane, A.; Gallaher, D. F. (Univ. of Western Ontario, London). J. Phys., B (London); 6: No. 11, 2334-2354 (Nov 1973).

The Wilets and Gallaher (Phys. Rev.; 147: 13-20 (1966)) formulation for H^+–H collisions was generalized to the heavy ion-atomic hydrogen collision. The resulting coupled differential equations were solved and a corresponding computer program was constructed to extract numerical results. Four-state calculations were carried out for the specific example of He^{2+}–H collisions using both eigenfunction and pseudostate expansion bases. Charge transfer, excitation and ionization cross sections as well as 2p polarization fractions are presented and compared with other theoretical calculations and experimental measurements where these are available. The computations encompass the range of He^{2+} energies from 6.3 keV to 4 MeV. It was found that: the neglect of rotational coupling effects underestimates charge transfer cross sections at impact energies of the He^{2+} ion less than about 15 keV; at high velocities of encounter the charge transfer cross section to the $He^+(1s)$ state predominates over that to the $He^+(2s)$ or $He^+(2p)$ state and is confined to a small range of impact parameters; excitation cross sections are sensitive to the choice of pseudo-states. It is further shown that an eigenfunction expansion basis is unlikely to reproduce the 1.2° total charge transfer probability experiment of Keever and Everhart (Phys. Rev.; 150: 43-7 (1966)) in a calculation employing a four-state approximation. (auth)

16836 INFLUENCE OF LONG-RANGE POLARIZATION ON SCATTERING CROSS SECTIONS FOR ELECTRON COLLISIONS WITH ALKALINE EARTH ATOMS. Fabrikant, I. I. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 5, 7-11(1973). (In Russian).

The scattering cross sections for the collision of slow electrons with alkaline earth atoms are calculated by the method of polarized orbits. The influence of exchange polarization on the cross section values is estimated. The results for Mg are compared with close coupling calculations. (auth)

16837 ELASTIC SCATTERING OF POSITRONS BY HELIUM IN THE CLOSE COUPLING APPROXIMATION. Wardle, C. E. (Hunter Coll., New York). J. Phys., B (London); 6: No. 11, 2310-2314(Nov 1973).

The close coupling approximation is applied to positron helium scattering with allowance for virtual positronium formation. The results are found to depend markedly on the choice of the target helium wave function. It is suggested that this is due to the violation of the bound principle for the close coupling approximation when inexact target functions are used. (auth)

16838 HYDROGEN CHARGE FRACTIONS FOR COLLISIONS OF H^- ON He, Ne, Ar, Kr, AND Xe. Bednar, J. A. Jr. New Brunswick, NJ; Rutgers–The State Univ. (1973). 170p. University Microfilms Order No. 73-27,894.

Thesis (Ph. D.).

Hydrogen charge fractions for collisions of H^- on He, Ne, Ar, Kr, and Xe were measured for incident H^- energies T_0 in the range of 0.9 to 30.0 keV and for laboratory scattering angles θ in the range of 0.3 to 10.0 degrees. The charge-fraction data exhibit significant simplification when plotted against the product $\tau = T_0\theta$. Screened-shell scattering potentials were fitted to differential scattering cross section data. The fitted screened-shell potentials were used to determine the impact parameter as a function of τ for the collisions studied. For H^- on He, P_{-1} has a minimum at $\tau = 1$ keV-deg.; and for $\tau > 5$ keV-deg. and $T_0 > 4$ keV, P_{-1} obeys the empirical formula $P_{-1} = 0.48 \exp(-v_0/v)$, where $v_0 = 2.0 \times 10^8$ cm/sec, and v is the incident H^- velocity. For H^- on Ne, Ar, Kr, and Xe in the range $\tau > 5$ keV-deg., P_{-1} and P_{+1}, when plotted against v^{-1}, exhibit oscillatory components which are 180 degrees out of phase with each other. The observed hydrogen charge-fraction behavior is compared with the behavior one might expect from crude molecular curve-crossing considerations, and several similarities are found. (Diss. Abstr. Int., B)

16839 COLLISION BROADENING OF ATOMIC SPECTRAL LINES BY NEUTRAL HYDROGEN ATOMS. Alferieff, M. E. La Jolla, San Diego, CA; Univ. of California (1973). 226p. University Microfilms Order No. 73-29,466.

Thesis (Ph. D.).

The quantum mechanical impact theory of line-shapes is discussed and applied to the computation of damping effects in atomic line radiation arising from depolarization collisions with neutral hydrogen atoms. The van der Waal's interaction is treated without the use of a multipole expansion and for an arbitrary collision geometry. Both diabatic and adiabatic collision processes are considered. For diabatic collisions it is found that the proper choice of collision geometry leads to a significant simplification of the interaction matrix relative to previous work. The interatomic exchange interaction is also considered. It is found that a correct treatment of the directionality of van der Waal's forces will lower the damping effects by about 15% for diabatic collisions. The adiabatic approximation lowers the damping effects by an additional 5% for excited p-states and may lead to a significant underestimation of damping effects in excited d-states. The exchange effects are found to be significant relative to the usual dipole-dipole approximation to van der Waal's interaction but

insignificant relative to the exact interaction. Computed enhancement factors for selected solar lines agree reasonably well with empirical values. (Diss. Abstr. Int., B)

16840 ELECTRON RESONANT SCATTERING FROM O_2 AND Ne. Haselton, H. H. Amherst, MA; Univ. of Massachusetts (1973). 180p. University Microfilms Order No. 73-31,098. Thesis (Ph. D.).

Resonant structure in the total cross section of electrons scattered from O_2 and Ne was studied by scattering a mono-energetic beam of electrons (8 to 40 mv F. W. H. M.) from a gas cell containing O_2 and Ne. The spectroscopic constants that describe the O_2^- $^2\Pi_g$ negative ion state and the parameters that determine the width and the shape of the Ne^- $^2P_{3/2,1/2}$ resonant doublet were measured. The resonant scattering energy positions of the successive vibrational states of O_2^- $^2\Pi_g$ were measured to a desired accuracy in order to determine the spectroscopic constants $\hbar\omega_e = 141$ mv and $2\hbar\omega_e X_e = 3$ mv ± 1 mv. The Ne^- $^2P_{3/2,1/2}$ doublet was observed at a scattering energy of approximately 0.5 eV below the threshold for excitation to the first excited state in Ne. Therefore, the structure in the total cross section is due solely to elastic scattering. Two Feshbach resonances are formed due to the two possible configurations of the l and S coupling of the Ne^+ core. The energy separation of this doublet was measured directly and found to be $\Delta E_R = 0.096 \pm 0.002$ eV. A convolution of the electron beam energy spread, the Doppler broadening due to the thermal velocities of the target, and the theoretical natural line shape which was developed by U. Fano was used to approximate the measured line shape. Both a Gaussian and a triangular distribution were used to approximate the energy distribution of the electron beam. A least-squares fit was made to this theory and the parameters $\Gamma = 8.95 \pm 0.34$ mv and $\delta_p = 156.18 \pm 0.44°$ were determined. (Diss. Abstr. Int. B)

16841 OSCILLATIONS OF THE TOTAL CROSS SECTION FOR THE CHARGE EXCHANGE REACTION pe + d → de + p. Matveenko, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2167-2173(Dec 1973). (In Russian).

The two-level approximation of the perturbed stationary states method is employed for calculation of the pe + d → de + p charge exchange reaction cross section. The cross section curve oscillates and a low frequency and high frequency components can be singled out. A partial analysis of the high frequency component is performed. (auth)

16842 LOW-ENERGY ELECTRON-COLLISION CROSS-SECTION DATA. III. Total Scattering; Differential Elastic Scattering. Kieffer, L. J. (Univ. of Colorado, Boulder). At. Data; 2: No. 4, 293-391(Jun 1971).

A compilation is made of low energy electron-collision cross section data. Experimental values only are presented for all atomic species and for those molecules which are important for aeronomy, astrophysics, and plasma physics. The data included are taken from the literature published through July 1970. (JFP)

16843 THEORETICAL ELECTRON SCATTERING AMPLITUDES AND SPIN POLARIZATIONS. Selected Targets, Electron Energies 100 to 1500 eV. Fink, M. (Univ. of Texas, Austin); Yates, A. C. At. Data; 1: No. 4, 385-456(Nov 1970).

In order to investigate the influence of the spin in elastic low-energy electron scattering from gaseous atoms, the Dirac equation was solved numerically. The complex scattering amplitudes, which describe the scattering process, are given. From the tables it is possible to determine such quantities as the elastic differential cross section, the spin polarization of elastically scattered electrons, the asymmetry of scattered electrons when the incoming electrons are already polarized, and the change of the polarization vector in a scattering experiment. Relativistic Hartree–Fock–Slater scattering potentials were used. The exchange of the incoming electron with the atomic electrons was not taken into account since it contributes very little except at the smallest angles where the wave-functions are already quite uncertain. Because of this the $\theta < 10°$ should be used with special care. (auth)

16844 LOW-ENERGY ELECTRON-COLLISION CROSS-SECTION DATA. II. Electronic-Excitation Cross Sections. Kieffer, L. J. (Univ. of Colorado, Boulder). At. Data; 1: No. 2, 121-287 (Nov 1969).

Graphical displays and tables of selected experimental data on cross sections for electronic excitation of some 20 atomic and molecular targets important in aeronomy, astrophysics, and plasma physics are presented. Values for both level and line excitation are given as functions of energy of the impacting electron. Criteria for data selection are discussed. The literature available through December 1968 was searched. (auth)

16845 CHARGE STATES OF 15 TO 140 MeV BROMINE IONS AND 15 TO 162 MeV IODINE IONS IN SOLID AND GASEOUS MEDIA. Datz, S.; Moak, C. D.; Lutz, H. O.; Northcliffe, L. C.; Bridwell, L. B. (Oak Ridge National Lab., TN). At. Data; 2: No. 4, 273-292(Jun 1971).

Graphs are presented for use in estimating equilibrium charge distributions in Br and I ion beams as they penetrate various gases and solids. Tables of the basic data are included. Additional graphs show nonequilibrium charge distributions as functions of target thickness for several Br and I ion energies for H_2, He, and Ar targets. (auth)

16846 QUANTUM DYNAMICAL THEORY OF MOLECULAR COLLISIONS. George, T. F. (Univ. of Rochester, NY); Ross, J. Annu. Rev. Phys. Chem.; 24: 263-300(1973).

The review covers differential and integral equations, mathematical techniques, reduction of the number of coupled equations, Faddeev equations, symmetry effects, and other effects. (JFP)

16847 TABLES FOR BORN APPROXIMATION CALCULATIONS OF K- AND L-SHELL IONIZATION BY PROTONS AND OTHER CHARGED PARTICLES. Khandelwal, G. S. (Old Dominion Univ., Norfolk, VA); Choi, B. H.; Merzbacher, E. At. Data; 1: No. 2, 103-120(Nov 1969).

Tables are presented for the calculation of the Born cross sections for ionization by proton impact of K- and L-shells and of individual L-subshells in atoms. The tables cover a wide range of proton energies above a few tenths of an MeV and many values of the atomic number, specified by dimensionless energy and screening parameters. Excitation functions for the K-shell are also tabulated as functions of the incident proton energy and the energy transfer. These are useful in estimating the energy distribution of delta rays and the K-shell correction to the stopping power of protons. (auth)

16848 EQUIVALENCE OF THE FIRST-ORDER GENERALIZED PHASE SHIFT AND FIRST-ORDER TIME-DEPENDENT PERTURBATION TREATMENTS OF ROTATIONAL EXCITATION. Pattengill, M. D. (Univ. of Kentucky, Lexington). Chem. Phys. Lett.; 23: No. 2, 278-280(15 Nov 1973).

For atom–rigid rotor scattering in the limit of high initial rotor states, it is shown that the first-order approximation of the GPS treatment is equivalent to first-order time-dependent perturbation theory with the assumption of curved, planar trajectories. (auth)

16849 ION–MOLECULE REACTIONS STUDIED AT NONZERO SCATTERING ANGLES IN A MASS SPECTROMETER. Cooks, R. G.; Kim, K. C.; Beynon, J. H. (Purdue Univ., West Lafayette, IN). Chem. Phys. Lett.; 23: No. 2, 190-193(15 Nov 1973).

A method is described by which ion–molecule reactions which involve nonzero scattering angles can be studied in a double-focusing mass spectrometer. Reactions in which there is no alteration in the charge on the reactant ion, while the target species is ionized or excited were examined at relative translational energies of 1 to 10 keV. The method allows the measurement of kinetic energy losses. Interference due to the main beam of nonreacting or elastically scattered ions is minimized relative to the zero scattering angle case. In addition to applications for the determination of ionization potentials and other quantities of thermochemical interest, it is suggested that the study of collisional excitation might be facilitated. (auth)

16850 ENERGY SPECTRA OF ELECTRONS EJECTED IN COLLISIONS OF FAST He METASTABLES WITH XENON. Lantschner, G.; Niehaus, A. (Univ., Freiburg i. B.). Chem. Phys. Lett.; 23: No. 2, 223-226(15 Nov 1973).

Energy spectra of electrons ejected in collisions of He metastables with Xe are measured for laboratory collision energies of He ranging from 30 up to 500 eV. It is shown that in this range the ionization process changes from Penning ionization to excitation transfer followed by atomic autoionization of Xe. (auth)

16851 POSITRON-HELIUM SCATTERING CROSS SECTIONS AND PHASE SHIFTS BELOW 19 eV. Jaduszliwer, B.; Paul, D. A. L. (Univ. of Toronto). Can. J. Phys.; 51: No. 14, 1565-1572(15 Jul 1973).

The total cross sections for elastic scattering of positrons in the energy range from 4 to 19 eV were measured by the method of transmission. By varying a magnetic field applied along the axis of the scattering chamber the transmitted fraction of the beam is altered, from which individual phase shifts can be extracted. s-, p-, and d-wave phase shifts are given over the entire energy range. The s-wave phase shifts are in agreement with values published by Drachman in 1968, while the p- and d-wave phase shifts are intermediate between values calculated by the

same author in 1966 and 1971. The experimental results agree with those of Costello et al., and marginally with 1972 results, but are significantly different from those of Canter et al. It is computed that the Ramsauer minimum in the diffusion cross section must be 0.04 πa_0^2 at 1.6 eV while the minimum in the total cross section is 0.11 πa_0^2 at 2.1 eV. The shoulder breadth observed in annihilation experiments is in nice agreement with what one would predict from the phase shifts. (auth)

16852 SPECTRAL RESPONSE OF PHOSPHORS TO FAST IONS. Hastings, L.; Goh, E. H.; Spenceley, B. J. (Lakehead Univ., Thunder Bay, Ont.). Can. J. Phys.; 51: No. 11, 1143-1147(1 Jun 1973).

The spectral distribution of the ionoluminescent response of a number of phosphors is compared to that of photoluminescence. For the single peaked phosphors, the response is the same. For a double peaked phosphor, Zn&Ag, Cu, the response is quite different. (auth)

16853 EXCITATION CROSS SECTION OF ALKALI-METAL ATOMS COLLIDING WITH SLOW ELECTRONS. Felden, M. M.; Felden, M. A. (Univ., Nancy). Can. J. Phys.; 51: No. 16, 1709-1714(15 Aug 1973).

A previously developed model is extended to the case of excitation of the alkali metals (Li, Na, K, Rb, Cs) by electron impact. The results of the cross section calculations to transitions $n_0s \rightarrow n_0p$ (n_0s being the ground state) are compared with experimental values. Numerical results concerning some other transitions are given in tabular form. (auth)

Atomic Theory

Refer also to abstract 17498.

16854 (IPNO/TH-73-28) SYMMETRY BETWEEN COULOMB ATTRACTION AND REPULSION IN RADIATIVE PROCESSES. Brussaard, P. J.; Klarsfeld, S. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.; Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). Jun 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

The role of analyticity in connecting attractive and repulsive orbital functions in the semiclassical theory of Coulomb excitation is reexamined in detail. It is then shown that the quantum-mechanical difference functions, which connect correspondingly the matrix elements of attractive and repulsive multipoles, can be similarly obtained by a residue calculation. The possibility of extending such relations to the relativistic Dirac case is also briefly discussed. (auth)

16855 INVESTIGATION OF EFFECTIVE POTENTIAL BARRIER. Case of Isoelectronic Sequence. Karosene, A. V.; Kiselev, A. A.; Karaziya, R. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 3, 363-374(1973). (In Russian).

The conditions for the existence of the effective "potential barrier" in atoms and ions as well as its dependence on the degree of ionization increases are considered. The contribution of the exchange part of Hartree–Fock potential is established and compared with its statistical approximation. As an example the isoelectronic sequence of XeI, with the configuration $4d^94f$, is analyzed. (auth)

16856 QUASI-DEGENERATE CONFIGURATIONS $ns^2np^N + np^{N+2}$. Kantseryavichyus, A. Yu. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 3, 355-361 (1973). (In Russian).

The two-configuration approximation $ns^2np^N + np^{N+2}$ (N = 1, 2, 3, 4) for the atoms and their positive ions in $3p^N$ and $4p^N$ configurations is considered. In the calculations the analytical radial orbitals are used. The energy contributions ΔE and the weights of correcting configurations λ are listed. (auth)

16857 APPROXIMATE DYNAMICAL SYMMETRY OF TWO-ELECTRON ATOMS. Wulfman, C. (Univ. of the Pacific, Stockton, CA). Chem. Phys. Lett.; 23: No. 3, 370-372(1 Dec 1973).

The eigenstates of a new set of approximate constants of the motion of two-electron atoms are very nearly those obtained by diagonalizing $1/r_{ij}$ within a complex. They are easily obtained by reducing SO(4) × SO(4) to SO(4) in a novel way. (auth)

16858 MATEMATICHESKIE OSNOVY TEORII ATOMA. (Mathematical Foundations of the Atomic Theory). Jucys, A. P.; Savukynas, A. Yu. Vilnyus, USSR; Institut Fiziki i Matematiki Akademii Nauk Litovskoi SSR (1973). 479p.

The monograph is intended for scientific workers specializing in the area of the quantum theory of atoms, atomic spectra, and related problems of contemporary physics. Methods for the construction of antisymmetric wave functions by means of one-electron wave functions (spin-orbital) and expressions of the matrix elements of the operators of atomic magnitudes through radial integrals are examined. For the shell of equivalence electrons the fractional parentage coefficient was used and for operators—the mathematical apparatus of irreducible tensor operators which includes both the electrostatic and the magnetic interactions. The material gave an account that can be used in cases of the consideration of correlations by the method of configuration coincidence (usual forms or the multiconfiguration approximation) or by expanded methods of calculation. It was made possible to formulate rapidly expressions for the matrix elements of operators. (tr-auth)

16859 DERIVATION OF THE HARTREE–FOCK EQUATIONS. II. Mayer, I. (Central Research Inst. for Chemistry, Budapest). Acta Phys. Acad. Sci. Hung.; 34: No. 1, 83-96(1973).

The UHF equations are derived from the variation principle by using only a single Lagrangian multiplier corresponding to the normalization of the total N-electron wave function, and by assuming the orthonormality of the one-electron orbitals only after the variation is performed. It is also shown that if the UHF equations are taken in the form $\hat{F}\psi_m = \sum_k^{\text{occ}} \langle \psi_k | \hat{F} | \psi_m \rangle \psi_k$ ($\hat{F}$ being the usual UHF operator), then their solutions are, in all nonsingular cases, automatically orthonormalized. A necessarily convergent procedure for the solution of these equations is discussed. (auth)

16860 MANY-BODY CALCULATIONS FOR THE HEAVY ATOMS. III. Pair Correlations. Morrison, J. C. (Chalmers Tekniska Hoegskola, Goteborg). J. Phys., B (London); 6: No. 11, 2205-2212(Nov 1973).

Corrections to the interaction integrals of 4f electrons, which are due to the interaction of configurations for which two f electrons are excited, are calculated with a pair function approach. Using first-order pair functions of this kind, second order and third order ladder diagrams are evaluated. The third order diagrams are quite small. This indicates a satisfactory convergence of the theory and means that an exact pair treatment is not necessary to deal with correlation effects among the f electrons. It is found that the second order results obtained in the Hartree–Slater potential introduced by Lindgren (Int. J. Quant. Chem.; 5: 411-9 (1971)) agree quite closely with Hartree–Fock results. Since the pair equation can more easily be solved in a local potential, the Hartree–Slater potential is probably a better starting point of perturbative calculations for the rare earth elements. (auth)

16861 HARTREE–FOCK PERTURBATION THEORY FOR SYSTEMS WITH ONE-PARTICLE PERTURBATION. Polak, R.; Kvasnicka, V. (Inst. of Physical Chemistry, Prague). Czech. J. Phys.; 23: No. 12, 1298-1304(1973).

The Hartree–Fock perturbation theory for the N-electron system with a one-particle perturbation is rederived using the resolvent operator formalism. It is shown that the second-order contribution to the total energy can be expressed in a compact form using a properly defined effective one-particle operator. Relations of the the Hartree–Fock perturbation theory with both the many-body theory and the regular Hartree–Fock formalism are discussed. (auth)

16862 COLLISIONAL AVERAGING OF THE STARK AND ZEEMAN SPECTRA STRUCTURE. Burshtein, A. I.; Smirnov, G. I. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2174-2184(Dec 1973). (In Russian).

The effect of depolarizing collisions on the shape of the spectrum in the quadratic Stark effect or anomalous Zeeman effect is considered. It is shown that collisions may result in merging (collapse) of the allowed spectral components. It is found that exchange between the Stark and Zeeman components can be observed by analyzing the structure of the Lamb dip. An additional (central) dip is detected. Methods for experimental determination of the collisional relaxation constants and of the parameters of the Stark and Zeeman structures of the spectrum are mentioned. (auth)

16863 STRUCTURE OF THE SECOND- AND THIRD-ORDER ENERGIES OF ATOMS. Sharma, C. S. (London Univ.); Rebelo, I. Can. J. Phys.; 51: No. 12, 1257-1260(15 Jun 1973).

It is shown that expressions for the second- and third-order Hartree–Fock energies can be deduced without using the second- and third-order Hartree–Fock equations and without the help of the Hellmann–Feynman theorem. The structure of the second- and third-order Hartree–Fock and correlation energies are studied in the light of the method recently developed by Sharma and Bowtell. (auth)

16864 TABLES OF OUTER S-FUNCTION PLETHYSMS. Butler, P. H.; Wybourne, B. G. (Univ. of Canterbury, Christ-

church, New Zealand). At. Data; 3: No. 2, 133-151(Sep 1971).

Tables of the outer S-function plethysm $\{\mu\} \otimes \{\lambda\}$ were machine computed for applications in the determination of group branching rules and for the resolution of the Kronecker squares of representations into their symmetric and antisymmetric parts. If (μ) and (λ) are partitions of the integers m and n, then the tables are complete to $mn \leq 16$ and include the case of $mn = 18$ for $(\lambda) = (2)$ and (11). (auth)

16865 REDUCED MATRIX ELEMENTS OF $V^{(12)}$, $V^{(13)}$, AND $V^{(14)}$ FOR d^n CONFIGURATIONS. Li, W. K. (Chinese Univ. of Hong Kong, Shatin). At. Data; 2: 263-271(Jun 1971).

The reduced matrix elements of $V^{(1k)}$ ($k = 2, 3, 4$) for d^n ($n = 2, \ldots, 5$) configurations are calculated and tabulated for general usage. These tables, along with those by Nielson and Koster, complete the presentation of the spectroscopic coefficients needed for the d^n configurations. (auth)

16866 NONRELATIVISTIC K-SHELL AUGER RATES AND MATRIX ELEMENTS FOR $4 \leq Z \leq 54$. Walters, D. L.; Bhalla, C. P. (Kansas State Univ., Manhattan). At. Data; 3: No. 4, 301-315(Dec 1971).

The Auger matrix elements and the rates for the K-LL Auger transitions for a vacancy in the K-shell are presented along with the fluorescence yields found with LS coupling. Numerical calculations were performed using the Hartree–Fock–Slater approach with the exchange approximation of Kohn and Sham and Gaspar. The results will be useful in the calculation of the Auger rates in the intermediate coupling scheme. (auth)

16867 CONFIGURATION INTERACTION MATRIX ELEMENTS FOR d^n CONFIGURATIONS. Barnes, J. A.; Carroll, B. L.; Flores, L. M. (Lockheed Electronics Co., Houston, TX). At. Data; 2: No. 2, 101-117(Apr 1971).

The coefficients of the matrix elements for configuration interaction between d^n and d^{n-1} l and also between d^n and $l^{4l+1}d^{n+1}$ are computed and tabulated for general use. The number of electrons, n, varies from 3 to 5; l is equal to s, d, g, i for the first set of interactions and to s, d for the second set. (auth)

16868 REDUCED MATRIX ELEMENTS OF TWO-ELECTRON DOUBLE-VECTOR OPERATORS FOR f^4 AND f^6. Crosswhite, H.; Judd, B. R. (Johns Hopkins Univ., Baltimore). At. Data; 1: No. 3, 329-357(May 1970).

Tables are presented for the reduced matrix elements of eight two-electron operators that all possess ranks of 1 in both spin and orbital spaces. These eight operators are required when the spin-other-orbit interaction is decomposed into its group-theoretical parts. However, in presenting the tables, it is intended that each of the eight parts should be parametrized separately, thereby allowing various species of configuration interaction to be included in the analysis. The range of the tables extends over all states of the configurations f^4 and f^6. (auth)

16869 CALCULATED IONIZATION POTENTIALS FOR MULTIPLY CHARGED IONS. Carlson, T. A.; Nestor, C. W. Jr.; Wasserman, N.; McDowell, J. D. (Oak Ridge National Lab., TN). At. Data; 2: No. 1, 63-99(Dec 1970).

Ionization potentials were calculated for all the elements up to $Z = 103$ for all states of ionization. The calculations are based on a simple spherical shell solution for neutral atoms. The average deviation of the calculated ionization potentials from experimental values was found to be about 5%. A simple method is also given for estimating the binding energies of electrons in all shells of a multiply charged ion from the calculated ionization potentials. (auth)

16870 MATRIX ELEMENTS OF ATOMIC INTERACTION OPERATORS FOR d^n CONFIGURATIONS. Barnes, J. A. (Lockheed Electronics Co., Houston, TX); Carroll, B. L.; Flores, L. M.; Hedges, R. M. At. Data; 2: No. 1, 1-43(Dec 1970).

The matrix elements of the Coulomb, spin-orbit, orbit-orbit, spin-other-orbit, and spin-spin operators for d^n ($n = 2, \ldots, 5$) configurations are computed and tabulated for general usage. Methods are also given for using the tables in calculating matrix elements for the conjugate configurations d^{10-n}. (auth)

16871 TABLES OF HYDROGENIC SLATER RADIAL INTEGRALS. Butler, P. H.; Minchin, P. E. H.; Wybourne, B. G. (Univ. of Canterbury, Christchurch, New Zealand). At. Data; 3: No. 2, 153-168(Sep 1971).

Slater radial integrals $R^k(n_1l_1n_2l_2; n_3l_3n_4l_4)$ were computed as products of powers of primes for hydrogenic radial eigenfunctions for all values of n and l up to $n = 4$ and $l = 3$. The decimal equivalents are also tabulated. A number of identities for hydrogenic Slater radial integrals were discovered. (auth)

16872 QUANTUM CORRECTIONS TO THE THOMAS–FERMI APPROXIMATION: THE KIRZHNITS METHOD. Hodges, C. H. (Queen's Univ., Kingston, Ont.). Can. J. Phys.; 51: No. 13, 1428-1437(1 Jul 1973).

The method of Kirzhnits for the calculation of quantum corrections to the Thomas–Fermi approximation is reviewed. An equation is derived whose iteration gives quantum corrections to the density matrix directly in terms of gradients of the potential. This is then used to calculate the correct form of the quantum correction to power 4 in the gradient operator. The validity of the quantum correction or gradient expansion method is examined by comparing the results of linear response theory using truncated gradient expansions with the exact Lindhardt result. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

16873 MAGNETOHYDRODYNAMIC WAVE KINETICS. III. Aleksin, V. F.; Khodusov, V. D. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 10, 1707-1716(Oct 1973). (In Russian).

Using the magnetohydrodynamic (MHD) wave interaction Hamiltonian constructed previously, the relaxation time of excitation was calculated in the slow magnetoacoustic wave spectra due to their interaction with each other which is possible with taking into account the oscillation frequency weak dispersion of the order V_A^2 in the $V_A^2 \gg V_S^2$ approximation. Decay processes of MHD waves with constant and chance phases were considered in plasma of strong gasokinetic pressure ($V_S^2 \gg V_A^2$). The Hamiltonian is obtained for four MHD waves interaction and by means of it the interaction of the Alfven waves with each other is considered. (auth)

16874 NONDISSIPATIVE CONDUCTING FLOWS WITH H^j LINES IN THE OSCULATING PLANE OF THE STREAMLINES. Rogers, C. (Univ. of Western Ontario, London). Can. J. Phys.: 51: No. 12, 1335-1340(15 Jun 1973).

A class of stratified magnetogasdynamic flows is analyzed by employing an anholonomic characterization of three-dimensional vector fields. Specific reference is made to helical flows of a conducting polytropic gas. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 16932–16935, and 16938.

16875 (RLO-2041-101) COMMENTS ON DIFFRACTIVE PROCESSES. Hwa, R. C. (Oregon Univ., Eugene (USA)). 1973. 19p. (CONF-730837-11). Dep. NTIS $3.00.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

Diagrams and a summary of the topics considered at the round-table discussion on diffractive processes are presented. (JFP)

16876 (UCSC-34-P-197-X-2) PROGRESS REPORT. (California Univ., Santa Cruz (USA)). 25 Oct 1973. Contract AT(04-3)-34. 8p. Dep. NTIS $3.00.

Experimental research in high energy physics is summarized. (JFP)

16877 PARTICLES AND FIELDS, 1973. 3rd Meeting of the American Physical Society, Berkeley, California, August 13–17, 1973. Bingham, H. H.; Davier, M.; Lynch, G. R. (Eds.). AIP Conference Proceedings, Number 14. Particles and Fields Subseries No. 6. New York; American Institute of Physics (1973). 687p. (CONF-730837-).

Forty-four papers are included under the following topics: weak and electromagnetic interactions and gauge theories; hadron spectroscopy and production mechanisms; experimental hadron physics at high energies; theoretical aspects of strong interactions at high energies; and astrophysics. Separate abstracts are prepared for thirty-nine papers. Five papers were previously abstracted for NSA and appeared in NSA under 29: 08727, 03547, 03630, 03406, and 08829. (LBS)

For abstracts of individual papers see: 15769, 16464, 16556, 16881–16883, 16896–16903, 16919–16921, 16942, 16956–16959, 16977, 16978, 16987–16995, 17009, 17020–17023, and 17047.

16878 HIGH ENERGY COLLISIONS, 1973. Fifth International Conference, Stony Brook, New York, August 23–24, 1973. Quigg, C. (ed.). AIP Conference Proceedings, Number 15. Particles and Fields Subseries No. 7. New York; American Institute of Physics (1973). 318p. (CONF-730841-).

Thirteen papers are included; separate abstracts are prepared for twelve. One paper was previously abstracted for NSA and appeared as 29:06268. (LBS)

For abstracts of individual papers see: 16904–16909, 16923, 16964, 16996, 17010, 17026, and 17027.

16879 HIGH ENERGY PARTICLE, COSMIC MESSENGERS. Vandermeulen, J. (Univ., Liege). Ciel Terre; 89: 157-183 (1973). (In French).

An attempt is made to give a simple and quite general review of studies concerning cosmic radiation. Major attention is given to cosmic radiation of a nuclear nature, since it can be considered in a self-sufficient manner. Cosmic radiation and elementary particles, the detection of cosmic particles of very high energy, and the astrophysics of cosmic radiation are discussed. Some properties of nuclear cosmic radiation, and the galactic and extragalactic theses are examined. (IAA)

Electromagnetic

Refer also to abstracts 16092 and 16949.

16880 (LAL-1267) STUDY OF THE PHOTOPRODUCTION OF π^- MESONS ON DEUTERONS IN THE REGION OF THE FIRST RESONANCE. Boucrot, J. (Paris-11 Univ., 91-Orsay (France)). Jun 1973. 207p. (In French). Dep. NTIS (U. S. Sales Only) $12.50.

Thesis.

An entirely new apparatus was used to study the $\gamma^+D \rightarrow \pi^-p^+p$ reaction. In this way, it was possible to detect particles in the final state in coincidence, a nonpolarized monochromatic photon beam being used. Results were obtained from the direct analysis of the results recorded on magnetic tape. The only detectors used were multiwire proportional chambers. The differential cross sections were determined for five energies covering the whole of the first resonance in the $\gamma^+n \rightarrow \pi^-p$ reaction. It was thus possible to demonstrate the validity of the spectator proton model in the $\gamma^+D \rightarrow \pi^-p^+p$ reaction for all the energies considered, and in particular, at the peak of the first resonance. The differential cross section of the $\gamma^+n \rightarrow \pi^-p$ reaction rapidly changes shape when going through the resonance and rapidly decreases at 180 deg. A conventional multipolar analysis explains this result, thus eliminating the possibility of an important isotensor contribution. (FR)

16881 SUMMARY OF e^+e^- COLLIDING BEAM EXPERIMENTS. Lynch, H. L. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 50-58(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Recent experiments related to $e^+e^- \rightarrow$ hadrons are discussed. Subjects discussed include hadron form factors, the total hadronic cross section, multiplicities and some specific channels. (auth)

16882 EXPERIMENTAL RESULTS ON PSEUDOSCALAR MESON PHOTOPRODUCTION. Quinn, D. J. (Tufts Univ., Medford, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 281-289(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The preliminary results of an experiment on photoproduction of the final states π^+N, $\pi^+\Delta$ (1236), $K^+\Lambda$ and $K^+\Sigma^+$ from hydrogen and deuterium targets using a 16 GeV linearly polarized photon beam are summarized. Momentum transfers (t) lie between -0.002 and -1.5 GeV^2. The photon polarization allows the separation of natural and unnatural parity exchange contributions to these reactions. The natural parity exchange cross sections dominate in all reactions for $|t| \geq 0.8$ GeV^2, where they all fall off approximately as e^{3t}. Combined with lower energy data, the results for $\gamma n \rightarrow \pi^-p$ are consistent with a simple pion Regge Pole behavior for the unnatural parity exchange cross section. Some results are compared with the vector dominant related reactions $\pi^-p \rightarrow \rho n$ and $\pi p \rightarrow \rho\Delta$. (auth)

16883 HYBUC AND PRELIMINARY REPORT ON THE Σ^+ MAGNETIC MOMENT EXPERIMENT. Doble, N. (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Gottstein, K.; Hansl, G.; Herynek, I.; Manz, A.; Marrafino, J.; Matt, W.; Settles, R.; Wolf, G.; Dahl-Jensen, E.; Reucroft, S.; Roos, C.; Webster, M. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 200-207(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A brief description is given of the Hyperon Bubble Chamber, HYBUC, a 32 cm hydrogen bubble chamber which is situated in a 110 kilogauss magnetic field produced by a superconducting magnet. A preliminary report is given on a precision measurement of the magnetic moment of the Σ^+ which was produced in the reaction $K^-p \rightarrow \Sigma^+\pi^-$. A summary of the published Σ^+ data is given along with an overview of various theoretical predictions. (LBS)

16884 INCLUSIVE PHOTOPRODUCTION OF π^0 MESONS AT 6 GeV. Berger, C.; Dick, G.; Erlewein, W.; Luebelsmeyer, K.; Paul, L.; Meyer-Wachsmuth, H.; von Dratzig, A. S. (Physikalische Institut der RWTH, Aachen). Phys. Lett.; 47B: No. 4, 377-380(26 Nov 1973).

An experiment was performed to study the inclusive photoproduction of π^0 mesons. Photoproduced π^0's were detected in a hodoscope consisting of 14 lead glass Cerenkov counters. To obtain the cross sections at a photon energy of 6 GeV the photon-difference method was used. Data are presented in terms of the Feynman variable $x = q^*_{\parallel}/(\sqrt{s}/2)$ and the transverse momentum $q_\perp$. Four $q_\perp$ distributions at $x = 0.2$, 0.4, 0.6 and 0.8 were measured. The results show that the π^0 rate at small values of $q_\perp$ is smaller than the π^+ rate. The data can be fitted smoothly by a form A exp $(-Bq_\perp^2)$ with a value of about 3.5 GeV^{-2} for the slope parameter B. (auth)

16885 ELASTIC ELECTRON DEUTERON SCATTERING. Berard, R. W.; Buskirk, F. R.; Dally, E. B.; Dyer, J. N.; Maruyama, X. R.; Topping, R. L.; Traverso, T. J. (Naval Postgraduate School, Monterey, CA). Phys. Lett.; 47B: No. 4, 355-358 (26 Nov 1973).

Measurements of the ratio of the deuteron to proton electric form factors were made for low q. The rms radius of the deuteron structure factor was found to be 1.9635 ± 0.0045 fm, yielding an rms charge radius of 2.095 ± 0.006 fm. (auth)

16886 GENERATION OF POWERFUL ELECTROMAGNETIC RADIATION PULSES BY A BEAM OF RELATIVISTIC ELECTRONS Kovalev, N. F.; Petelin, M. I.; Raizer, M. D.; Smorgonskii, A. V.; Tsopp, L. E. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 4, 138-140(20 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 4, 232-235(20 Aug 1973).

The results of an experimental study of induced Cherenkov excitation of electromagnetic radiation in the centimeter band by a beam of relativistic electrons from a strong-current accelerator are given. The conversion coefficient of electron energy into electromagnetic radiation is 12 to 15%. (auth)

16887 SINGLE CHARGED PION PHOTOPRODUCTION FROM CARBON ABOVE 300 MeV. Endo, I. (Hiroshima Univ.); Baba, K.; Fujii, H.; Sumi, Y.; Anami, S.; Ninomiya, S.; Kato, S.; Murakami, A. Phys. Lett.; 47B: No. 5, 469-472(10 Dec 1973).

Momentum spectra of charged pions in photoproduction on carbon nuclei were measured at a lab angle 28.4° for quasi-monochromatic photons of 50 MeV width in the energy range between 300 and 850 MeV. The behavior of resulting cross sections is discussed. (auth)

Weak

Refer also to abstract 17036.

16888 (ANL/HEP-7350) QUASI-ELASTIC NEUTRINO REACTIONS: FORM FACTORS. Derrick, M. (Argonne National Lab., Ill. (USA)). 1973. 56p. (CONF-730842-5). Dep. NTIS $5.00.

From international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973).

The experimental situation on two-body neutrino reactions is summarized. The interactions $\nu + n \rightarrow \mu^- + p$, $J + p \rightarrow \mu^+ + \Lambda$, and $\nu + p \rightarrow \mu^- + \Delta^{++}$. The data are discussed with particular reference to their bearing on the determination of the axial vector form factor. (JFP)

16889 (LBL-2158) MUON DEPOLARIZATION IN MATTER. Crowe, K. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1973. Contract W-7405-eng-48. 47p. (CONF-730849-1). Dep. NTIS $4.50.

From summer study group on practical applications of accelerators; Los Alamos, New Mexico, USA (27 Aug 1973).

The lecture covers muons as a probe, medium effects, experimental techniques, depolarization—fast and slow, and applications in chemistry, biology, and solids. (JFP)

16890 STUDY OF THE IONIZATION BURSTS PRODUCED BY A GROUP OF PENETRATING PARTICLES IN THE CALORIMETER. Aglamazov, V. A.; Gedevanishvili, L. D.; Petrosyan, Zh. S.; Robakidze, Z. P.; Sakvarelidze, I. I.; Khazaradze, N. G. Soobshch. Akad. Nauk Gruz. SSR; 72: No. 1, 60-64(Oct 1973). (In Russian).

A special installation of an ionization calorimeter type located underground at 130 MW(e) was used at the Cosmic Ray Laboratory of the Tbilisi State University for the study of structural ionization bursts caused by the penetrating particles of cosmic radiation. The possibility of a nontrivial process of production of superhigh energy muons is discussed on the basis of the experimental data. (auth)

16891 MEASUREMENT OF RADIATION $\Sigma^+ \rightarrow n\pi^+\gamma$ DECAY. Ebenhoeh, H.; Eisele, F.; Filthuth, H.; Hepp, V.; Leitner, E.; Thouw, T.; Zech, G. (Univ., Heidelberg). Z. Phys.; 264: No. 5, 413-422(1973).

The radiative $\Sigma^+ \rightarrow n\pi^+\gamma$ decay mode was analyzed in the 81 cm SACLAY hydrogen bubble chamber exposed to a stopping K^- beam at the CERN PS. The pion spectrum was measured up to momenta of 150 MeV/v in the Σ rest frame. The following branching ratios were obtained based on $180 \Sigma^+ \rightarrow n\pi^+\gamma$ and 292 $\Sigma^- \rightarrow n\pi^-\gamma$ events: $R(\Sigma^+ \rightarrow n\pi^+\gamma)/R(\Sigma^+ \rightarrow n\pi^+) = (0.93 \pm 0.10) \times 10^{-3}$ and $R(\Sigma^- \rightarrow n\pi^-\gamma) = (0.46 \pm 0.06) \times 10^{-3}$. An unambiguous assignment of S-wave to the $\Sigma^- \rightarrow n\pi^-$ and P-wave to $\Sigma^+ \rightarrow n\pi^+$ was obtained. The absolute and differential decay rates as well as the parity assignments are in good agreement with theoretical predictions. (auth)

16892 SEARCH FOR $K_S \rightarrow 2\gamma$ DECAY. Barmin, V. V.; Barylov, V. G.; Davidenko, G. V. (Inst. of Theoretical and Experimental Physics, Moscow). Phys. Lett.; 47B: No. 5, 463-464(10 Dec 1973).

Using the 180-liter liquid xenon bubble chamber a search for the $K_S \rightarrow 2\gamma$ decay was carried out. The branching ratio $\Gamma(K_S \rightarrow 2\gamma)/\Gamma(K_S \rightarrow \text{all}) < 4.0 \times 10^{-4}$ was found with 90% confidence level. (auth)

16893 SEARCH FOR THE $K_S \rightarrow 2\gamma$ DECAY. Barmin, V. V.; Barylov, V. G.; Davidenko, G. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 6, 1236-1238(Dec 1973). (In Russian).

The ITEP 180-litre xenon bubble chamber was used to search for the $K_S \rightarrow 2\gamma$ decay. It is found that $\Gamma(K_S \rightarrow 2\gamma)/\Gamma(K_S) < 4.0 \cdot 10^{-4}$ at 90% confidence level. (auth)

Strong (Baryon-induced)

Refer also to abstracts 15766, 17021, 17026, and 17032.

16894 MEASUREMENT OF THE POLARIZATION PARAMETER IN NEUTRON-PROTON CHARGE EXCHANGE SCATTERING FROM 2 TO 12 GeV/c. Ruchti, R. C. East Lansing, MI; Michigan State Univ. (1973). 148p. University Microfilms Order No. 73-29,772.

Thesis (Ph. D.).

An experimental measurement of the polarization parameter in neutron-proton charge exchange scattering for incident momenta 2 to 12 GeV/c and four momentum transfers $0.01 \leq |t| \leq 1.0$ $(GeV/c)^2$ is described. Using a polarized target and a two-arm spectrometer, a sample of 1.1×10^7 triggers was collected from which 3×10^5 elastic events were extracted with a 3-constraint fit. The results show a polarization whose magnitude increases monotonically with $|t|$ to roughly 60% for $|t| \gtrsim 0.6$ $(GeV/c)^2$ and which has relatively little energy dependence. A detailed comparison of the data with several current phenomenological models is made. (Diss. Abstr. Int., B)

16895 INCLUSIVE γ PRODUCTION FROM 12.4 GeV/c PROTON-PROTON INTERACTIONS IN THE ANL 12-FT BUBBLE CHAMBER. Swanson, D. L. Chicago; Illinois Inst. of Tech. (1973). 168p. University Microfilms Order No. 73-27,067.

Thesis (Ph. D.).

The results of a study of inclusive γ production from 12.4-GeV/c proton-proton interactions are presented. A final sample of 3694 γ conversions in the hydrogen-filled 12-ft bubble chamber at Argonne National Laboratory was obtained. Total cross sections for inclusive γ and π^0 production are presented. Using measurements of proton-proton inelastic and topological cross sections, the average γ and π^0 multiplicities as well as the γ and π^0 multiplicity distributions are calculated as a function of the number of charged tracks at the primary vertex. These results are compared with the existing data. The invariant and noninvariant cross sections are also studied in detail. The measurement of the invariant cross section is compared with a similar measurement at the CERN Intersecting Storage Rings and conclusions are reached concerning scaling behavior in the invariant cross section. The γ noninvariant cross section is used to calculate distributions of components of π^0 momenta which are then compared with similar distributions of π^+ produced in 12 GeV/c proton-proton collisions. Comparisons of inclusive π^0, π^+, and π^- cross sections at ~12 GeV/c with higher energy data are presented. Knowing the inclusive cross section for π^+, π^- and π^0 at ~12 GeV/c, the average number of neutrons produced per inelastic pp collision is calculated. (Diss. Abstr. Int., B)

16896 BARYON EXCHANGE PROCESSES. Parsons, A. S. L. (Rutherford Lab., Chilton, Eng.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 290-298(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Data from recent hyperon exchange processes are summarized. Direct evidence for A dominance over Σ exchange above about 2.5 GeV/c cm energy is provided by these data. The dip structure and exchange mechanism in recent $\bar{p}p \rightarrow \pi^-\pi^+$, K^-K^+ data are discussed. (auth)

16897 DIFFRACTIVE PROCESSES. Leith, D. W. G. S. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 326-358(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

New data on diffractive processes from current experiments at NAL and the ISR are reviewed. (auth)

16898 PROTON DIFFRACTION DISSOCIATION DATA FROM THE CERN ISR. Goldhaber, G. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 386-394(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The study of diffraction dissociation of the proton carried out in the double-arm magnetic spectrometer experiment at CERN is described. (LBS)

16899 COMMENTS ON DIFFRACTION DISSOCIATION. Lee-Franzini, J. (State Univ. of New York, Stony Brook). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 395-399(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Comments are made on an experimental study of the $p + p \rightarrow$

p + X interaction, where X is the quasi-particle composed of all else excluding the recoil proton. Various estimates of the diffractive dissociation cross sections are discussed. (LBS)

16900 DIFFRACTION DISSOCIATION IN pp INTERACTIONS AT NAL. Whitmore, J. (National Accelerator Lab., Batavia, IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 371-377(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A brief summary is presented of the study of diffractive fragmentation in pp collisions as observed in the NAL bubble-chamber experiments. Missing mass, effective mass, and secondary particle rapidity distributions permit (a) the study of the multiplicity and t dependences of the diffractive process at high energy, (b) the measurement of the cross section for the reaction $pp \to pp\pi^+\pi^-$, and (c) an estimate of an upper limit for the double Pomeron exchange contribution to the $pp\pi^+\pi^-$ final state at 205 GeV/c. (auth)

16901 REACTION pp → p + X AT 405 GeV/c. Seidl, A. A. (Univ. of Michigan, Ann Arbor). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 378-380(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Preliminary results on the reaction pp → p + X from an exposure of the NAL 30 inch liquid hydrogen bubble chamber are presented. Single particle inclusive distributions are discussed and compared with corresponding data at 102 GeV/c. (auth)

16902 MEASUREMENT OF p + p → p + X BETWEEN 50 AND 400 GeV. Abe, K. (Rutgers-the State Univ., New Brunswick, NJ); DeLillo, T.; Robinson, B.; Sannes, F.; Carr, J.; Keyne, J.; Siotis, I. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 381-385 (1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The s, t and x dependence of the invariant cross section was measured for the inclusive reaction p + p → p + X in the region $108 < s < 752$ GeV^2, $0.14 < |t| < 0.38$ GeV^2 and $0.80 < x < 0.93$. The data were taken during the acceleration ramp of the National Accelerator Laboratory machine using the internal H_2 jet target facility. (auth)

16903 EXPERIMENTAL INCLUSIVE γ, K°, Λ, AND $\bar{\Lambda}$ PRODUCTION. Ljung, D. (National Accelerator Lab., Batavia, IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 464-478(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Recent results of six experiments studying inclusive neutral particle production are summarized and compared. The beam momentum ranges from 10.5 GeV/c to 205 GeV/c. (auth)

16904 TOTAL CROSS SECTIONS AND RELATED PHENOMENA AT ISR ENERGIES. Cocconi, G. (CERN, Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 1-8(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

The results of recent measurements of proton-proton total cross sections are presented. A plausible extrapolation to higher energies of the cross sections of other hadrons is discussed. (auth)

16905 RESULTS FROM THE PISA-STONY BROOK ISR EXPERIMENT. Bellettini, G. (Univ., Pisa, Italy). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 9-46(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

An updated report is given on the results on (a) proton-proton total cross section, (b) single-particle angular distributions, (c) clustering of charged secondaries in inelastic events, and (d) correlations among charged secondaries. (auth)

16906 RECENT RESULTS FROM THE NAL BUBBLE CHAMBER. Vander Velde, J. C. (Univ. of Michigan, Ann Arbor). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 124-146(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

A summary of results obtained during the last few months from the 30-inch hydrogen bubble chamber at National Accelerator Laboratory is presented. (auth)

16907 P-P INELASTIC SCATTERING AT SMALL MOMENTUM TRANSFER. Lee-Franzini, J. (State Univ. of New York, Stony Brook). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 147-179(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

A series of experiments on proton-proton inelastic scattering were performed at NAL and ISR. The four-momentum transfer in these experiments ranges from .01 to 1.75 (GeV/c)^2 and the equivalent laboratory momentum ranges from 50 to 2,000 (GeV/c). The results clearly show the existence of two components. For one of these the cross section $d^2\sigma/dtdM_X^2$ scales as $1/s$. For small M_X^2 a second component is present. Its cross section is independent of energy and is bounded by $3.2 < \sigma_{diff} < 4.7$ mb. (auth)

16908 REVIEW OF LARGE TRANSVERSE MOMENTUM PHENOMENA IN HADRON COLLISIONS. Walker, J. K. (National Accelerator Lab., Batavia, IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 247-274(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

Recent experimental data from NAL and the ISR on large transverse momentum single particle production in proton-proton collisions are reviewed. The approach to energy scaling, particle ratios, and associated multiplicities, etc. are discussed. (auth)

16909 CHARGED MULTIPLICITY ASSOCIATED WITH TRANSVERSE MOMENTUM OF A LEADING PROTON IN PP AT 28.5 GeV/c. Ramanuaukas, A. (Brookhaven National Lab., Upton, NY); Anderson, E. W.; Fisher, G. P. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 307-313(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

The mean charged multiplicity $\bar{n}_{CH}$ was measured as a function of transverse momentum $p_\perp$ of the forward proton in the reaction p + p → p + MM for five intervals of missing mass MM using our Multiparticle Argo Spectrometer System. An increase of $\bar{n}_{CH}$ for $p_\perp > 1$ GeV/c was observed. (auth)

16910 ANALYSIS OF pp ANNIHILATION REACTIONS IN FLIGHT BY A MULTIPERIPHERAL MODEL INCLUDING RESONANCES. de la Vaissiere, C. (LPNHE, Paris). Nuovo Cim., A; 19: No. 1, 118-140(1 Jan 1974).

The experimental results of 3 annihilation reactions ($\bar{p}p \to 2\pi^+2\pi^-$, $2\pi^+2\pi^-\pi^0$, $3\pi^+3\pi^-$) are compared with the prediction of a model in a range of $\bar{p}$ momentum from 1 to 7 GeV/c. This model is derived from the multiperipheral model of Chan, Łoskiewicz and Allison, and includes the production of mesonic resonances. Pions and resonances are considered coupled to a nucleon Regge trajectory exchanged between the proton and the antiproton. The intensity of the coupling is supposed to decrease rapidly with the meson mass. If one introduces only pions and resonances of lower masses decaying into 2 or 3 pions (ρ, ω, f°, ...), it is possible to describe the dominant features of the 3 reactions. A general agreement is obtained with mass and angular distributions, resonance production rates, probabilities of intermediate channels, variation of cross sections with energy. According to the model, the final state of the annihilation seems the result of many intermediate channels, each channel resulting in turn of several peripheral mechanisms. (auth)

16911 PRODUCTION OF γ, Λ^0, K_S^0 AND $\bar{\Lambda}^0$ IN pp COLLISIONS AT 102 GeV/c. Chapman, J. W. (Univ. of Michigan, Ann Arbor); Cooper, J.; Green, N.; Roe, B. P.; Seidl, A. A.; Vander Velde, J. C.; Bromberg, C. M.; Cohen, D.; Ferbel, T.; Slattery, P. Phys. Lett.; 47B: No. 5, 465-468(10 Dec 1973).

Cross sections were measured for γ, K_S^0, Λ and $\bar{\Lambda}$ production at 102 GeV/c and the following were found: $\sigma(\gamma) = 170 \pm 16$ mb., $\sigma(K_S^0) = 4.6 \pm 0.5$ mb., $\sigma(\Lambda) = 3.2 \pm 0.4$ mb., and $\sigma(\bar{\Lambda}) = 0.23 \pm 0.10$ mb. Both $\langle n_{\pi^0} \rangle$ and $\langle n_{K_S^0} \rangle$ appear to rise linearly with n_- while the ratio $\langle n_{K_S^0} \rangle / \langle n_{\pi^0} \rangle$ is approximately independent of n_-. The integrated invariant cross section as a function of x as well as $d\sigma/dy$ and $d\sigma/dp_T^2$ are presented and compared with other data. (auth)

16912 MEASUREMENT OF THE CROSS SECTIONS FOR INCLUSIVE $\pi^- + p \to \pi^- + X^+$ REACTIONS AT MOMENTA 42 AND 51 GeV/c IN THE BEAM FRAGMENTATION REGION. Derevshchikov, A. A.; Dmitrevskii, Yu. P.; Matulenko, Yu. A.; Melnik, Yu. M.; Meshanin, A. P.; Mysnik, A. I.; Nurushev, S. B.; Proskurin, G. P.; Smirnov, E. V.; Siksin, V. V.; Solovjev, L. F.; Solovyanov, V. L. (Inst. for High Energy Physics, Serpukhov, USSR). Phys. Lett.; 47B: No. 5, 473-476(10 Dec 1973).

Inclusive cross sections for $\pi^- + p \to \pi^- + X^+$ reaction were measured for the interval $x = p/p_{max} = 0.90-0.99$ at the momenta 42 and 51 GeV/c and the values of the momentum transfer squared $p_\perp^2 = 0.04 + 0.26$ (GeV/c)^2. With the increase of x one can observe some growth of invariant differential cross section at p^2 fixed in the indicated interval. In the Regge pole model such a behavior may be explained by a predominating contribution of the vacuum pole. Under this assumption the energy dependence of the total cross section for Pomeron interaction with protons at several values of $p_\perp^2$ was found. (auth)

Strong (Meson-induced)

Refer also to abstract 17326.

16913 (ANL/HEP-7344) MEASUREMENT OF POLARIZATION IN $\pi^-p \to K^0\Lambda^0$ AT 5 GeV/c. Ward, C. E. W.; Ambats, I.; Lesnik, A.; Meyer, W. T.; Rust, D. R.; Yovanovitch, D. D. (Argonne National Lab., Ill. (USA)). Sep 1973. 12p. Dep. NTIS $3.00.

The Λ^0 polarization in $\pi^-p \to K^0\Lambda^0$ at 5 GeV/c using 3709 events where the decay products of both the K^0 and the Λ^0 were observed has been measured. It is found that the polarization is small and positive for small $-t$, passes through zero near $-t = 0.3$ (GeV/c)^2, and becomes large and negative at larger $-t$, consistent with a value of -1.0 for $-t \geq 0.7$ (GeV/c)^2. (auth)

16914 (COO-2197-16) PION-NUCLEON INTERACTION AND MESONIC ATOMS. Progress Report, February 1, 1973–January 31, 1974. Rebka, G. A. Jr.; Kunselman, R. (Wyoming Univ., Laramie (USA)). 1974. Contract AT(11-1)-2197. 9p. Dep. NTIS $3.00.

During the year February 1, 1973, to January 31, 1974, research under Task A: pion-nucleon interaction at LAMPF has primarily been further preparation for LAMPF Experiment #99, "Measurement of the Cross Section for $\pi^- + p \to \pi^- + \pi^+ + n$ with a Magnetic Spectrometer." The silicon surface barrier detectors were received and tested, the magnets and stand are scheduled for delivery before the end of February, and the vacuum chamber is under construction "in house". The design and objectives of the experiment were thoroughly reviewed to develop a plan to use the reduced intensities immediately available at LAMPF. Study of a scheme to monitor high intensity pion beams was begun. The progress on Task B: mesonic atoms has included observation of sigma-atomic x rays with high Z nuclei which determined limits on the sigma magnetic moment. A modified muonic atom experiment to operate at reduced intensities has been planned for LAMPF. In preparation, tuning the muon channel was done. Continuation of the measurements of antiprotonic x rays was planned for Argonne after the "improvement shutdown" is over. A list of publications is included. (auth)

16915 (LBL-2106) SEARCH FOR POMERON–POMERON-2π EVENTS IN 205 GeV/c π^-p INTERACTIONS. Chew, D. M.; Abrams, G. S.; Bingham, H. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 23p. Dep. NTIS $4.00.

Pomeron–pomeron-2π vertices were sought in the reaction $\pi^-p \to \pi^-\pi^+\pi^-p$ at 205 GeV/c. From a sample of 186 of these events, about $\frac{1}{3}$ were extracted for which the rapidity ordering of the four outgoing particles makes them candidates for the double-Pomeron exchange process (i.e., the fastest and the slowest particle are respectively a π^- and a proton). A separation from single-Pomeron processes was attempted with the help of a rapidity triangle plot. The number of possible double-Pomeron-type events was also estimated from a Regge-propagator fit to the nonhomogeneous distribution of the events within this triangle. The number of such events obtained by either method gives a cross section upper limit of 65 μb for double-Pomeron exchange, consistent with the predictions of a pion-pole dominance model. (auth)

16916 (NP-19917) SINGLE PHOTOPRODUCTION OF π^- ON NEUTRONS IN DEUTERIUM IN THE REGION OF THE PION–NUCLEON RESONANCES P_{11}, D_{13}, AND S_{11}. Note No. 418. Beneventano, M.; d'Angelo, S.; de Notaristefani, F.; Monacelli, P.; Paoluzi, L.; Proia, A.; Sebastiani, F.; Severi, M. (Rome Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 14 Dec 1972. 38p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.00.

The results obtained in a study of the single photoproduction of π^- on neutrons in deuterium with an experimental apparatus consisting of counters, scintillation chamber, and an analyzing magnet were reported. The experimental equipment and the processing of the results are described. The results are shown graphically. The polarization of the recoil proton is measured and an expression for it is given. The value of the e.m. coupling of the P_{11} isobaric state is large. The contribution of the D_{13} isobaric state is rather depressed. The e.m. coupling of the S_{11} isobaric state is very large. (JSR)

16917 (ORO-2504-211) DIFFERENTIAL CROSS SECTIONS FOR K^+p ELASTIC SCATTERING FROM 0.865 TO 2.125 GeV/c-DATA LISTING. Technical Report No. 74-023. Abe, K.; Barnett, B. A.; Goldman, J. H.; Laasanen, A. T.; Steinberg, P. H.; Marmer, G. J.; Moffett, D. R.; Parker, E. F. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Sep. 1973. 27p. Dep. NTIS $3.50.

The results of an experiment to obtain high precision differential cross sections for elastic $K^+ + p$ scattering are tabulated. The total cross sections obtained from a fit to Legendre polynomials are also given. (JFP)

16918 DETERMINATION OF AN UPPER LIMIT FOR THE RADIATIVE DECAY WIDTH GAMMA($K^{*+}_{890} \to K^+\gamma$) IN COHERENT PRODUCTION ON NUCLEI. Freudenreich, K. (Technische Hochschule, Zurich). Helv. Phys. Acta; 46: No. 3, 340-370 (1973). (In German).

The coherent production of K^*_{890} on nuclei was investigated with a large magnet spark chamber at 10, 13 and 16 GeV/c. The K^*_{890} events found in the data exhibit the behavior expected for coherent production. A model is presented which describes the coherent production of K^*_{890} in terms of the strong and electromagnetic interactions including their interference. A comparison of the model with the data shows the strong production to be dominant and larger than expected. Via the interference with the Coulomb amplitude the phase of the strong production amplitude can be determined. Finally the upper limit for the radiative decay width is found to be smaller than 80 keV with 95% confidence. (auth)

16919 REVIEW OF EVIDENCE FOR HIGH MASS K* STATES. Carmony, D. D. (Purdue Univ., Lafayette, IN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 156-162(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Evidence for strange mesons above the K*(1420) is reviewed. The $K_N(1760)$ now appears to be well confirmed with a 9 GeV/c K^+n experiment reporting a mass of 1769 ± 12 MeV and a width of 130 ± 50 MeV and a 7.2 GeV/c K^-p experiment finding a mass of about 1760 MeV and a width of less than 80 MeV. Decays into $K\pi$, $K\rho$, $K^*(890)\pi$ and $K^*(890)\rho$ are seen. The K^+n experiment also reports a state of mass 2115 ± 45 MeV and width 300 ± 100 MeV which is identified with a previously reported antilambda-nucleon state. Decays into $K\pi$, $K^*(890)\pi$, K_0, $K^*(890)\rho$, $K^*(1420)\pi$ and Kf are also found. A 12 GeV/c K^+n experiment finds a single broad enhancement in the high $K\pi$ mass region. (auth)

16920 PRECISION MEASUREMENTS OF $K^\pm$ AND $\bar{p}$ TOTAL CROSS SECTIONS ON HYDROGEN AND DEUTERIUM BELOW 1.1 GeV/c. Carroll, A. S.; Chiang, I. H.; Kycia, T. F.; Li, K. K.; Mazur, P. O.; Michael, D. N.; Mockett, P. M.; Rahm, D. C.; Rubinstein, R. (Brookhaven National Lab., Upton, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 208-221(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Precision measurements of $K^\pm$ and $\bar{p}$ total cross sections on both hydrogen and deuterium in the momentum range from 400 to 1100 MeV/c are presented. Structures are seen in all of the channels. (auth)

16921 DIFFRACTION DISSOCIATION IN 205 GeV/c π^-p INTERACTIONS. Winkelmann, F. C. (Univ. of California, Berkeley); Abrams, G. S.; Bingham, H. H. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 359-370(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Pion and proton diffraction dissociation are observed in π^-p interactions at 205 GeV/c. The 2- and 4-prong final states show evidence for N* and A_1 production. Pion diffraction into masses up to ~6 GeV is observed in the inclusive reaction $\pi^-p \to p + X$. (auth)

16922 FINAL STATE INTERACTION IN PION ELECTROPRODUCTION FROM NUCLEI NEAR THRESHOLD. Borie, E. (Michigan State Univ., East Lansing); Chandra, H.; Drechsel, D. Phys. Lett., 47B: No. 4, 291-293(26 Nov 1973).

Cross sections for pion electroproduction from nuclei near threshold, including the distortion of the pion wave function by the pion-nucleus optical potential. Distortion effects near threshold are found to be significant, changing the ratio $\sigma_{\pi^-}/\sigma_{\pi^+}$ for production of 10 MeV pions from ^{16}O by nearly fifty percent. (auth)

16923 NONPERIPHERAL TWO-BODY REACTIONS. Lundby, A. (CERN, Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 232-246(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841–.

Two-body hadronic collisions behave, in the absence of the dominant peripheral components diffraction and particle exchange, in similar ways as concerns energy dependence ($s^{-10\pm2}$) and the absence of peaking $d\sigma/dt$ in t or u. They may phenomenologically be classed as a third, "nonperipheral", component of strong interactions. Some of the experimental information on forward, backward, and 90° c.m. scattering are presented. The 90° c.m. K^+p and π^+p elastic differential cross sections decrease as s^{-8}, which is slower than pp (s^{-10}). Superimposed on the very fast energy dependence, there are indications of modulations $d\sigma/dt$ for π^+p elastic scattering at large momentum transfers at 5 GeV/c, which we tentatively ascribe to Ericson fluctuations. (auth)

16924 DETERMINATION OF TOTAL ηN INTERACTION CROSS SECTION IN η-MESON PHOTOPRODUCTION FROM COMPLEX NUCLEI. Dudkin, G. N.; Eponeshnikov, V. N.; Krechetov, Yu. F.; Tryasuchev, V. A. (Tomsk Polytechnic Inst., USSR). JETP Lett. (USSR) (Engl. Transl); 18: No. 4, 157-158(20 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 4, 263-266(20 Aug 1973).

The incoherent process $\gamma + A_1 \rightarrow \eta + A_f$ from C, Cu, Ag, and Pb was investigated at a maximum bremsstrahlung beam energy $E_{\gamma max}$ = 900 MeV and at a c.m.s. η-meson emission angle θ^*_η = 90°. The η mesons were detected by registering the two γ quanta from the $\eta \rightarrow 2\gamma$ decay. The total ηN-interaction cross section was determined by using the dependence of the η-meson yield from the nuclei on the mass number A and by using the optical model; it was found to be $\sigma^{tot}_{\eta N} = (66 \pm \frac{22}{30})$ mb. (auth)

16925 PRODUCTION OF NEUTRAL STRANGE PARTICLES IN π^-p, π^-n, AND π^-C INTERACTIONS AT 40 GeV/c. Dubna-Budapest-Bucharest-Krakow-Sofia-Tashkent-Tbilisi-Ulan-Bator-Hanoi Collaboration. Yadern. Fiz.; 18: No. 6, 1251-1261(Dec 1973). (In Russian).

Inclusive cross sections of $\Lambda(\Sigma^0)$-hyperon and K^0-meson production in π^-p, π^-n and π^-C interactions and cross sections of ΛK^0-, K^0K^0- and $K\bar{K}$-pair production are obtained as well as the corresponding topological cross sections for the π^-p interactions. The cross section $\sigma^{\pi^-p}_{\Lambda(\Sigma^0)+\ldots}$ at 40 GeV/c is about twice as much as that in the interval 10–25 GeV/c. The $K\bar{K}$-pair production cross section keeps on increasing with the primary π^--meson energy. The mean K^0 meson number per a π^-p interaction event is 0.24 ± 0.03 and $\langle\Lambda\rangle$ = 0.07 ± 0.01. Inclusive Λ and K^0_1 spectra are presented. The normalized invariant Λ-hyperon and K^0_1-meson cross sections for the π^-p interactions at 40 GeV/c are compared with the cross sections at less energies, as well as with the pp interactions at 205 GeV. (auth)

16926 REACTION $\pi^-p \rightarrow \eta^0 n$ IN THE MOMENTUM REGION UP TO 50 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Kut'in, V. M.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Semenov, V. K. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 6, 1262-1269(Dec 1973). (In Russian).

The differential cross sections of the reaction $\pi^-p \rightarrow \eta^0 n$, $\eta^0 \rightarrow 2\gamma$ are measured in the energy region from 20–50 GeV at the 4-momenta $-t \leq 3$ (GeV/c)^2. The cross sections exponentially decrease and the forward scattering cone slowly shrinks with increasing the π^--meson momentum. At $-t \approx 1.1$ (GeV/c)^2 the differential cross sections pass through a flat minimum. The parameters of the A_2-trajectory which is substantially nonlinear are determined. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 15771.

General

Refer also to abstracts 17326 and 17505.

16927 (ANL/HEP-7345) CAN MUELLER REGGE MODELS DESCRIBE INCLUSIVE DATA CONSISTENTLY? Pinsky, S. S.; Thomas, G. H. (Argonne National Lab., Ill. (USA)). Oct 1973. 49p. (COO-1545-133). Dep. NTIS $4.50.

An attempt is made to understand, both phenomenologically and theoretically, the details of inclusive processes. A complete phenomenological analysis of all inclusive pion data in the central region is presented (in the context of the Mueller-Regge picture with three trajectories P, ρ and f). Particular attention is paid to the constraints of charge conjugation and the approach to scaling. All the data are found to fit quite well, including two-body correlations, which were in considerable variance in previous treatments. One consequence is the prediction that ππ correlations scale from above. At NAL energies, the nonscaling part is found to be large. The constraint on the couplings (γ) imposed by charge conservation, $\gamma^{PP} = 4(\gamma^{Pp})^2/\alpha_P - \alpha_\rho$, is satisfied. In addition, a number of couplings are found to be approximately exchange degenerate. Based upon the phenomenological indications, an attempt is made to construct the simplest possible Mueller-Regge model with three trajectories obeying the constraints of charge conservation and with an exchange degenerate ρ and f. It is found that it is not possible to consistently construct such a model without adding additional physical mechanisms such as narrow width resonances. Nevertheless, a model satisfying the above constraints without an exchange degenerate ρ and f can be constructed and has many interesting properties that are borne out by the data. In the calculation of this model, extensive use is made of the recently proven equivalence of the Mueller-Regge and multiperipheral model. (auth)

16928 (NP-19911) GETTING DOWN TO FUNDAMENTALS? The Particle Spectrum. Butterworth, I. (Imperial Coll. of Science and Technology, London (UK)). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

An account is given of the interactions and properties of the various types of sub-atomic particles, with particular stress on the quark model. The account discusses a number of questions. Do exotics exist? Do new quantum numbers appear at higher energies? Does SU(3) hold at high energies? What is the pattern of the masses of states of the same quantum numbers? What is the pattern of higher spin states: do their masses go on to infinity or saturate? It is concluded that what used to be called elementary particles do not constitute the fundamentals, but that in their spectrum, glimpses are seen of half truths suggesting an approach to an understanding of some more basic structure of matter. (UK)

16929 (RLO-2041-105) ANNUAL REPORT, 1973. Moravcsik, M. J. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 31 Oct 1973. Contract AT(45-1)-2230. 7p. Dep. NTIS $3.00.

A summary of research on particle theory is presented covering high energy scattering models and the polarization structure of particle reactions. A list of publications issued during the period is appended. (JFP)

16930 STATUS OF THE LOCAL CURRENT ALGEBRA PROGRAM. Leutwyler, H. (Univ., Bern). Acta Univ. Wratislaviensis; 2: No. 164, 22-31(1972).

A review lecture is given on the status of the local current algebra without entering into any of the technical subtleties of the subject. It is noted that the local current algebra program has up till now not led to any interesting new structures. The known solutions are all equivalent to currents associated with simple field theories. (JFP)

16931 LOCAL QUASIPOTENTIAL EQUATION FOR THE RELATIVISTIC TWO-BODY PROBLEM. Todorov, I. T. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Univ. Wratislaviensis; 2: No. 164, 1-21(1972).

The discussion covers the quasipotential equation for scalar particles and the quasipotential approach to electromagnetic interactions. (JFP)

16932 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 21, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 104p.

16933 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 22, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 107p.

16934 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 23, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 110p.

16935 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 24, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 83p.

16936 COMMUTATORS NEAR THE LIGHT-CONE AND BJORKEN LIMITS STUDY OF LADDER MODELS. Menotti, P. (Scuola Normale Superiore, Pisa, Italy). Acta Univ. Wratislaviensis; 2: 66-90(1972).

In these lectures Bjorken limits and scale invariant behavior are considered with particular reference to ladder models. The approach used consists in working directly in configuration space and looking for the singularities of matrix elements of current cummutators on the light cone. (JFP)

16937 RENORMALIZATION CONSTANTS OF STABLE AND UNSTABLE PARTICLES WITH SPIN. Ebert, D. (Humboldt Univ., Berlin). Acta Univ. Wratislaviensis; 2: No. 164, 146-167(1972).

In this lecture a short review is given of the definition of the wave function and vertex renormalization constants of stable particles. First the corresponding decomposition of the partial wave amplitude in the unstable particle case is given. Then a simple Zachariasen-like model with singularities in the j-plane is defined by using the Reggeon perturbation theory of Gribov. (JFP)

16938 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 20, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 87p.

16939 RELATIVISTIC METHOD OF PHASE FUNCTIONS. Babikov, V. V.; Grusha, G. V.; Mir-Kasimov, R. M.; Shul'gina,

N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 17: No. 3, 391-406(Dec 1973). (In Russian).

In the frame of finite-difference formalism of quasipotential scattering theory the phase functions method is generalized for the case of the interaction of two relativistic particles. (auth)

16940 GENERAL VERTEX FUNCTION IN THE MODEL WITH THE FINITE SET OF OSCILLATIONS. Popov, Kh.; Stoyanov, D. (Joint Inst. of Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 17: No. 3, 332-341(Dec 1973). (In Russian).

Using the representation of the group SL (2,R) in the space of the coherent states of 5-dimensional oscillators an operator was obtained which corresponds to the general vertex function. With the aid of this operator the diagram with semimultiperipheral configuration of the external particles is also constructed. (auth)

16941 CURRENT COMMUTATORS ON THE LIGHT CONE AND THE PERTURBATION THEORY. Usyukina, N. I. Teor. Mat. Fiz.; 17: No. 3, 359-372(Dec 1973). (In Russian).

The behavior of the matrix element of the commutator of conserved currents between one-nucleon states with zero momentum transfer in a scalar gluon model in the second order in the gluon-nucleon coupling constant is considered on the light cone. The main singularity of this matrix element is also investigated in the ladder approximation. (auth)

16942 UNIFIED GAUGE THEORIES OF SPIN $J \leq 1$. Halpern, M. B. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 120-129(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

An overview is given of structure and development within the unified gauge theory of strong, weak, and electromagnetic interactions. This type of model gives an explicit renormalizable description of all known particles with spin $J \leq 1$, plus a few conjectured ones like W-mesons etc. By "all", is meant all, including such diverse particles as ρ-mesons, quarks, pion, kaons, Buddha (1235) meson, ρ' (1600), leptons, etc. In these models, all spectra and forces between particles derive from spontaneously broken gauge invariance and incorporate the ideas of Yang and Mills, Weinberg, Salam, tHooft, and others. A brief review is given of the structure of these models, then some of the more striking results therein are described. Finally these models are compared with the "underlying-field" or quark models advocated by other workers. Although there are some important differences, it appears that in general the models here (M-models) are closely connected to the quark models—the former providing a lower energy explicit realization of the latter. (auth)

16943 CUTTING OFF OF PARTICLE MOMENTA IN THE INCLUSIVE PROCESS IN THE DOMAIN OF LARGE ANGLES. Ezhela, V. V.; Logunov, A. A.; Mestvirishvili, M. A.; Petrov, V. A.; Rcheulichvili, G. L. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 17: No. 3, 327-331(Dec 1973). (In Russian).

It is shown that local analyticity and unitarity lead to logarithmic cutting off of particle momenta, when particles are detected in the binar inclusive process in the domain of large angles. (auth)

16944 COLOR THE QUARK MUON. Kalbfleisch, G. R. (Brookhaven National Lab., Upton, NY); Fowler, E. C. Nuovo Cim., A; 19: No. 1, 173-178(1 Jan 1974).

It is proposed that the leptons are quarks. Unstable baryonic quarks must also exist. A specific scheme based on the Han-Nambu model is presented. Conservation of the quantum numbers is obtained in all processes except the purely nonleptonic ones. (auth)

16945 QUANTIZED DE SITTER SPACE, THE CONNECTION TO THE PAULI PRINCIPLE AND AN APPLICATION TO FEYNMAN'S RELATIVISTIC QUARK THEORY. II. Ulmer, W. (Univ., Stuttgart). Int. J. Theor. Phys.; 8: No. 3, 199-209(1973).

A model of a quantized space-time theory was investigated previously. Consideration is given to further problems of a quantized De Sitter space. It is shown that a De Sitter space is a very useful starting point to a nonlocal relativistic quantum field theory, containing the Pauli principle, for the theory of elementary particles, as a connection to Feynman's relativistic quark theory, where the group SU(3) has a particular importance. This method offers the possibility of treating weak local differences from a space with De Sitter metric as a perturbation. Therefore the problem of a fundamental elementary length 1_0 must be considered in connection with the general theory of relativity. (auth)

16946 CAUSAL APPROXIMATION SCHEME FOR THE COMMUTATOR OF THE AXIAL VECTOR-CURRENTS. Kemmler, K.; Marinescu, N. (Univ., Heidelberg). Z. Phys.; 265: No. 4, 325-334(Nov 1973).

An approximation scheme which fulfils the causality condition is used to compute the matrix elements of the commutator of two axial-vector currents between one proton state. The commutator sum rule is supposed to be saturated by taking into account the nucleon, the $N^*(^5/_2, ^3/_2)$ resonance, and the partially disconnected pion-proton intermediate states. For the axial current form factors pion pole formulas are assumed. It is shown that only the subtraction constants are relevant for the equal time limit of the commutator and so the equivalence with similar earlier methods is proven. (auth)

16947 EVALUATION OF DUAL FERMION AMPLITUDES. Schwarz, J. H.; Wu, C. C. (California Inst. of Tech., Pasadena). Phys. Lett.; 47B: No. 5, 453-456(10 Dec 1973).

The calculation of fermion–fermion ground-state scattering in the ten-dimensional dual theory is reported. The crossing properties of the amplitudes are discussed. (auth)

Electromagnetic

Refer also to abstracts 17495 and 17545.

16948 (CNRS-CPT-73-P-546) MODEL FOR SPIN PARTICLES IN THE ELECTROMAGNETIC AND GRAVITATIONAL FIELD. Sourisu, J. M. (Centre National de la Recherche Scientifique, 13 – Marseille (France). Centre de Physique Theorique). Jun 1973. 88p. (In French). Dep. NTIS (U. S. Sales Only) $6.50.

A universal particle model was constructed in which it is assumed that the dipolar moments reduce to a kinetic moment and a magnetic moment in a momentum frame. In this way, a deterministic model is obtained for the elementary particles. The elementary particle is defined only in terms of the parameters appearing in the universal model i.e. momentum, spin, charge, and the electromagnetic moment. The model meets the following requirements: conformity with the universal electrodynamical equations (hyperspace formulas), determinism of the differential system, and existence of a symplectic structure and a prequantum structure. In addition, this model enables a description to be obtained of all the point (or complex particle) systems such as electrons, molecules, or stars as far as it is possible to neglect the quadrupolar moments. (auth)

16949 (DESY-73-44) ELECTROMAGNETIC INTERACTIONS. Ting, S. C. C. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 48p. Dep. NTIS (U. S. Sales Only) $4.50.

Lectures are given on the study of quantum electrodynamics in the interaction between photons and electrons or muons, vector dominance in the interaction between real photons and vector mesons, and scaling and structure functions in the interaction between virtual photons and hadrons. (JFP)

16950 (KFTI-73-4) CALCULATIONS FOR THE POLARIZATION OF COHERENT BREMSSTRAHLUNG OF ELECTRONS IN THE LU-2000 LINEAR ACCELERATOR WITH THE VK-40 HYDROGEN BUBBLE CHAMBER. Vatset, P. I.; Vinckurov, E. A.; Get'man, V. A.; Koltunov, I. A.; Lyakhno, Yu. P.; Nikitin, V. A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 12p. (In Russian). INIS.

The possibility of experiments on the determination of the degree of polarization of a beam of coherent electron bremsstrahlung of the linear accelerator LU-2000 by maximum probability method, the measured azimuthal angle distribution of the flight of electrons in the hydrogen bubble chamber, was investigated. It was shown that at beam densities guaranteeing 5 triplets on the stereophotographs ~250,000 stereophotographs are necessary to attain a precision of ~16%. (tr-auth)

16951 (ORO-3992-151) NEW LOW ENERGY THEOREMS FOR $\gamma \rightarrow 3\pi$ AND $\gamma\gamma \rightarrow 3\pi$. Mendes, R. V. (Texas Univ., Austin (USA). Center for Particle Theory). 1973. 8p. (CPT-196). Dep. NTIS $3.00.

New low energy theorems are obtained by relaxing the requirement that the $\gamma\gamma \rightarrow 3\pi$ amplitudes vanish in the neutral soft pion limit. In the framework of a particular model it is shown that the relation $eF_{3\pi} = F_\pi f^{-2}$ may have to be generalized to involve also the $\gamma\gamma \rightarrow 2\pi$ amplitudes. (auth)

16952 (ORO-4317-33) MESON EXCHANGE EFFECTS ON THE CHARGE FORM FACTORS OF THE TRI-NUCLEON SYSTEM. Technical Report 74-043. Kloet, W. M.; Tjon, J. A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Dec 1973. 14p. Dep. NTIS $3.00.

The presence of meson exchange currents in the tri-nucleon system is shown to modify significantly the charge form factor of ^{3}He in the region of the dip and the secondary maximum. As a result the fit to experimental data is considerably improved at high momentum transfer. (auth)

16953 LOW ENERGY AND ASYMPTOTIC BEHAVIOR OF THE INVARIANT AMPLITUDES OF THE DEUTERON COMPTON EFFECT. Maksimenko, N. V.; Moroz, L. G.; Kong Wang Fong (Inst. of Physics, Minsk). Vestsi Akad. Navuk USSR, Ser. Fiz.-Mat. Navuk; No. 2, 94-101(1973). (In Russian).

The behavior of the invariant amplitudes of the deuteron Compton effect was considered in the regions of low and high energies. An analysis of the amplitudes in the high energy region was conducted within the framework of a relativistic pulsed approximation. On the basis of an investigation of the behavior of these amplitudes dispersion rules for the deuteron Compton effect were obtained. (tr-auth)

16954 TRANSITION RADIATION IN DIELECTRIC PLATE IN WAVEGUIDE AT PASSING ON A CHARGED PARTICLE PERPENDICULAR TO WAVEGUIDE AXIS. Barsukov, K. A.; Begloyan, E. A.; Gazazyan, Z. D.; Gevorkyan, E. A.; Laziev, E. M. (c). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 6, 397-405(1972). (In Russian).

Properties of transition radiation generated by charged particle in dielectric plate in a regular waveguide are considered. It is assumed that the particle crosses a waveguide perpendicular to its axis. The field and energy of particle radiation and its spectrum are obtained. It was shown that in a certain part of the spectrum the radiation is locked in the plate. (auth)

16955 RADIATION GENERATED IN A STACK OF PLATES BY A CHARGE IN THE VICINITY OF BRAGG FREQUENCIES. Avakyan, A. L.; Garibyan, G. M.; Yang, G. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; R8: No. 1, 3-11 (1973). (In Russian).

The exact formulas for the transition radiation generated in a stack of plates in the vicinity of Bragg frequencies are analyzed. Two special cases were considered: the dielectric constant of the plate close to unity; it is large, but the thicknesses of plates are small. In both cases narrow but high peaks were proved to exist analogous to ones found in the continuous periodic medium by the method of two-wave theory. The formulas for the stack and the continuous medium are compared. (auth)

16956 ANTI-NUCLEON PRODUCTION AT SPEAR. Berk, D. (Univ. of California, Los Angeles); Buchanan, C.; Drickey, D.; May, C.; Shepard, P.; Stork, D.; Zdarko, R.; Dakin, J.; Seppi, E. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 59-64(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The results are reported of an initial survey for antiproton and antineutron inclusive events produced at SPEAR by colliding electron and positron beams of 5.2 GeV center-of-mass energy. The following were obtained: an upper limit with 90% confidence that $\sigma(\bar{p}) < 5 \times 10^{-34}$ cm^2; and an upper limit with 90% confidence that $\sigma(\bar{n}) < 2 \times 10^{-33}$ cm^2. (LBS)

16957 ELECTRON-POSITRON ANNIHILATION INTO HADRONS. Cahn, R. N. (Stanford Univ., CA); Ellis, J. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 65-79(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Theories about the behavior of the ratio $\sigma(e^+e^- \to \gamma \to \text{hadrons})/\sigma(e^+e^- \to \gamma \to \mu^+\mu^-)$ are reviewed, and qualitative features of the final state hadron distributions are discussed. (auth)

16958 EXPERIMENTAL RESULTS ON DEEP INELASTIC LEPTOPRODUCTION. Barish, B. C. (California Inst. of Tech., Pasadena). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 80-97(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A review of recent results for both deep inelastic electroproduction and neutrino scattering is presented. (auth)

16959 EXPERIMENTAL RESULTS ON SCALING AND THE NEUTRON TO PROTON CROSS SECTION RATIO IN DEEP INELASTIC ELECTRON SCATTERING. Bodek, A. (Massachusetts Inst. of Tech., Cambridge); Breidenbach, M.; Dubin, D. L.; Elias, J. E.; Friedman, J. I.; Kendall, H. W.; Poucher, J. S.; Riordan, E. M.; Sogard, M. R.; Coward, D. H. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 98-101(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A review of present knowledge about the scaling of the neutron and proton structure functions and about the neutron to proton cross section ratio is presented. Emphasis is placed on the results of a recent electron scattering experiment at SLAC from which neutron cross sections were extracted from deuterium data using an impulse approximation. (auth)

16960 RADIATIVE CORRECTIONS TO BREMSSTRAHLUNG RADIATION AT HIGH ENERGIES. Kuraev, E. A.; Lipatov, L. N.; Merenkov, N. P.; Fadin, V. S. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2155-2160(Dec 1973). (In Russian).

Radiative corrections to the cross section for single scattering of bremsstrahlung radiation by oppositely moving e^+e^- (e^-e^-) beams are obtained in an experiment in which the total energy carried away by photons in the direction of one of the initial particles is recorded whereas the radiation in the direction of motion of the other particle is not recorded. The results may also be applied to the problem of radiative corrections to bremsstrahlung radiation produced by electrons scattered by nuclei. (auth)

16961 ANGULAR DISTRIBUTION OF NEUTRONS ELASTICALLY SCATTERED ON DEUTERONS. Komarov, V. V.; Popova, A. M.; Serebryakov, S. G. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1677-1680(Aug 1973).

A particular solution of the integral equations for the amplitude of the elastic n,d scattering was examined. The differential cross section of the elastic n,d scattering was calculated for energies of 40, 77, 155, and 340 MeV. (tr-auth)

16962 INDUCED RADIATION OF NEUTRAL FERMI PARTICLES HAVING ANOMALOUS MAGNETIC AND ELECTRIC MOMENTS IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE. Klimenko, Yu. I.; Khudomyasov, A. I. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 59-64(1973). (In Russian).

The induced radiation of neutral Fermi particles having anomalous moments in a field of plane waves was examined. An exact solution of the general Dirac equation was found. The solution obtained was used for the investigation of the effect of the anomalous electric moment of the particle on the induced radiation. (tr-auth)

16963 ELECTRON-POSITRON COLLISIONS. Litke, A. M.; Wilson, R. Sci. Amer.; 229: No. 4, 104-113(Oct 1973).

A general review is given of the theoretical and experimental study of electron-positron collisions. The production of positron beams is discussed, and properties of storage rings are described. The four categories of experiments performed with storage rings are discussed: tests of the theory of quantum electrodynamics; the search for new particles, experiments with "equivalent photon" beams; and the production of strongly interacting particles. (LBS)

16964 HADRONIC AND ELECTROMAGNETIC INTERACTIONS AT LARGE TRANSVERSE MOMENTUM. Brodsky, S. J. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc; No. 15, 275-306(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

The scaling laws of inclusive and exclusive processes at large transverse momentum are reviewed. Their theoretical interpretation in terms of composite models for the hadrons is then discussed. The observed inverse power-law behavior of the invariant cross sections at fixed invariant ratios is found to agree with the degrees of freedom suggested by the simple dimensional counting in the quark model. Such counting is characteristic of renormalizable quark field-theoretic models with asymptotically scale-invariant constituent interactions and finite Bethe-Salpeter wavefunctions. However, as suggested by the parton interchange model, elementary gluon interactions between quarks of different hadrons must be suppressed in order to understand (1) the scaling, but not scale-invariant behavior of the inclusive hadronic cross section for meson production at large transverse momentum, and (2) the effective Regge behavior at large t and angular distributions of exclusive hadronic and electromagnetic processes. (auth)

16965 PLASMA DYNAMICS AND THE PHOTON MASS. Park, D. (Williams Coll., Williamstown, MA). J. Phys., A (London); 6: No. 12, 1949-1953(Dec 1973).

The plasma mechanisms underlying a recent proposal (Williams and Park, Phys. Rev. Lett.; 26: 1657-2 (1971)) for setting an upper limit on the mass of the photon are clarified by the study of a simplified model. (auth)

16966 MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS OF NUCLEONS. Hosek, J. (Inst. of Nuclear Physics, Prague). Czech. J. Phys.; 23: No. 10, 1014-1017(1973).

Using the concept of spontaneous breakdown of the symmetry in the framework of the Yang-Mills-Higgs-Kibble formalism, the unified model of weak and electromagnetic interactions of point nucleons is suggested. (auth)

16967 MODIFICATIONS OF THE FUBINI-DASHEN-GELL-MANN SUM RULE FOR COMPTON SCATTERING. Abdel-Rahman,

A. M. M. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim.; 19A: No. 1, 53-68(1 Jan 1974).

Possible modifications of the nonforward Fubini-Dashen-Gell-Mann (FDG) sum rule in non-Abelian Compton scattering are investigated in the cases when the forward sum rule has 1) the form proposed by Barry, Gounaris and Sakurai, and 2) the usual form. The condition for the equivalence of the relations which arise on differentiating the FDG sum rule with respect to q^2 and t, at $q^2 = 0$, $t = 0$, is also discussed. It is suggested that this work provides a mechanism in which recent objections to the Cabibbo-Radicati sum rule can be overcome. (auth)

16968 MULTILOOP AMPLITUDES IN ADDITIVE DUAL-RESONANCE MODELS. Montonen, C. (Cambridge Univ., Eng.). Nuovo Cim.; 19A: No. 1, 69-89(1 Jan 1974).

A technique is developed by which general multiloop amplitudes in additive dual-resonance models can be calculated, with spurious states propagating internally in the loops, however. The result shows the same automorphic structure as has been found in the Veneziano model. The case of the Neveu-Schwarz model is considered in more detail. (auth)

16969 SUM RULES AND LIGHT-CONE SINGULARITIES. Venturi, G. (Univ., Bologna). Nuovo Cim.; 19A: No. 1, 1-12 (1 Jan 1974).

Finite-energy sum rules for the imaginary part of a current-hadron scattering amplitude are related to the general light-cone commutator of the two currents. The conditions for which the usual fixed, or quasi-fixed, mass sum rules are reproduced are examined and general relations are obtained between the deep inelastic structure functions. The possible restrictions on the functions appearing in the light-cone commutator are discussed. The pion-nucleon scattering amplitude is also related to the electromagnetic deep inelastic structure functions for the neutron and the proton, and an estimate is made of the effective "mass" of the current constituents which is found to be small. (auth)

16970 DERIVATION OF THE GRIBOV-LIPATOV RECIPROCITY RELATION IN A SCALING BOOTSTRAP MODEL. Schierholz, G. (Stanford Univ., CA). Phys. Lett.; 47B: No. 4, 374-376(26 Nov 1973).

The Gribov-Lipatov reciprocity relation $\nu\overline{W}_2(\omega) = -\omega^{-3}\nu W_2$ (ω^{-1}) is shown to be valid in a scaling bootstrap model under certain assumptions. (auth)

16971 MESON AND NUCLEON FORM FACTORS WITH ρ, ω, AND φ DOMINANCE. Renard, F. M. (USTL, Cedex, France). Phys. Lett.; 47B: No. 4, 361-364(26 Nov 1973).

Using unitarity and analyticity the effects on the ρ propagator of the energy dependence of the width and of a strong inelasticity are studied. A simple form for the ρ propagator is proposed which is able to fit the pion, kaon and nucleon form factors in the space-like and time-like region. (auth)

16972 NEW VALUE OF THE ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON. Calmet, J.; Peterman, A. (CERN, Geneva). Phys. Lett.; 47B: No. 4, 369-370(26 Nov 1973).

The contribution to the sixth order anomaly $a_e^{(6)}$ from light-by-light scattering subgraphs is recomputed. The result is: $a_e^{\gamma\cdot\gamma} = (\alpha^3/\pi^3)(0.366 \pm 0.010)$. This result agrees with a previous calculation done at SLAC. The accuracy is improved by a factor of 4. With the currently accepted values for many of the other diagrams, the sixth order anomaly is: $a_e^{(6)} = (1.16 \pm 0.07)\ (\alpha/\pi)^3$. (auth)

16973 IDENTITY OF ELECTRONS IN THE FINAL STATE IN PAIR PRODUCTION IN COLLIDING e^+e^- BEAMS. Kuraev, E. A.; Lipatov, L. N.; Strikman, M. I. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 6, 1270-1282(Dec 1973). (In Russian).

The contribution of interference to electron-positron pair production in colliding beams is considered up to logarithmic terms. Energy spectra of the final particles are represented. Disagreement of the results with numerical calculations of other authors is discussed. (auth)

16974 SOME RESULTS OF THE USE OF THE FIVE-DIMENSIONAL EQUATION FOR INVESTIGATION OF THE INTERACTION OF PARTICLES WITH SPIN ½. Bedritskii, A. I. (Vitebsk State Pedagogical Inst., USSR). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 3, 64-73(1973). (In Russian).

Methods were indicated and the results obtained on the solution of some problems on electromagnetic interaction (annihilation, Compton effect, bremsstrahlung, scattering, hydrogen atom, etc.) of particles with spin ½ on the basis of the five-dimensional equation were reported. The five-dimensional equation includes the previously introduced hypothesis on mirror (R) particles and simulates gravitational interaction accompanying electromagnetic interaction with some examples. The results obtained do not in all cases agree with the corresponding results of quantum electrodynamics. The relativistic approximation agrees in all problems with the exception of annihilation. In the five-dimensional theory of electromagnetic interaction there are P and T invariance but not C invariance in all cases. The value found for the lost C invariance of the probability of three-photon annihilation of the parapositronium in the S state is close to the results of the one known experiment. In all the problems examined the effective cross sections were obtained identically for the usual and R particles; in two cases the equations of state were different. (tr-auth)

16975 NONRELATIVISTIC APPROXIMATION TO THE PROBLEM OF COULOMB SCATTERING OF POLARIZED PARTICLES WITH SPIN 3/2 ON THE BASIS OF THE FIVE DIMENSIONAL THEORY. Bedritskii, A. I. (Vitebsk State Pedagogical Inst., USSR). Vestsi Akad. Navuk BSSR, Ser, Fiz.-Mat. Navuk; No. 4, 61-66(1973). (In Russian).

It was shown that the discrete characteristics of η particles and antiparticles with spin 3/2, introduced earlier in the five-dimensional theory, have the same meaning as for spins 1/2 and 1 and produce helicity of the particles and antiparticles relative to the nature and values of $\eta = \pm 1$ correspond with the normal (L) and mirror (R) particles. On the basis of the five-dimensional formulas the nonrelativistic approximation to the problem of the scattering of particles with heavy Coulomb centers was examined. The cross section was the same for L and R particles. The probability of the L ⇌ R transition during scattering is zero. The results obtained for the effective cross section do not agree during all changes of the polarization with the corresponding results of the four-dimensional theory. (tr-auth)

Weak

16976 (CRN/HE-73-11) MUON MASS AND THE UNIFIED GAUGE FIELD THEORY FOR LEPTONS. Leite Lopes, J. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

A mixing angle is introduced into the interaction between the Higgs doublet scalar field and leptons in the Weinberg 2-1 model so as to make this interaction universal and to account for the electron-muon mass difference. The idea is extended to the 2-2 model where there should be a mass difference between the muonic and the electronic heavy leptons. (auth)

16977 AUG. 1973: REVIEW OF LATEST RESULTS FROM HIGH ENERGY NEUTRINO EXPERIMENTS. Wachsmuth, H. (CERN, Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 2-19(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A brief description is given of the ANL, CERN, and NAL experiments. The results of charged weak current studies with muonic neutrinos and with electron neutrinos are reviewed. Searches for neutral currents and heavy leptons are then described. (LBS)

16978 REVIEW OF K^0 DECAYS. Nygren, D. R. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 20-49(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A review is given of selected topics in K^0 decays for which recent results have led to substantial progress and/or controversy. (auth)

16979 DUAL-PARTON MODEL PCAC AND THE GOLDBERGER-TREIMAN RELATION. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta). Particles Nucl.; 5: No. 5-6, 177-182(1973).

On the basis of the dual-parton model of hadrons, which does not take into account the role of infinite number of pions in pion cloud in eN′ deep inelastic scattering as well as in the dual resonance model of strong interactions, the validity of PCAC has been introduced from the dynamics of pion emission mechanism and weak interaction. It is shown that we can have a dynamical interpretation of the PCAC relation and the Goldberger-Treiman relation on the basis of this dual parton model of hadrons. (auth)

16980 POSSIBLE ROLE OF UNIVERSAL LENGTH IN THE THEORY OF WEAK INTERACTIONS. Kim, D. Y. (Univ. of Saskatchewan, Regina). Can. J. Phys.; 51: No. 14, 1577-1581 (15 Jul 1973).

The discovery and role of already existing universal constants

h and c in modern physics were reviewed from a particular point of view. This viewpoint is characterized by a pattern of logic in terms of which one may possibly find a new universal constant, i.e. the elementary length. One of the main objectives is to find out whether the elementary length introduced this way would resolve inherent difficulties in relativistic quantum field theory. This was explicitly studied in terms of the nonlocal field theory in connection with the CP violating kaon decay. This produced a relation $\eta = ia_0 m_K c/\hbar$ which leads, on the one hand, to a consistent explanation of the possible mechanism of CP violation and, on the other hand, gives a result which is most probably the first direct link between the elementary length (nonlocality) and an experiment without having the inherent disorder in the small distance behavior in quantum field theory. (auth)

16981 SLOPES OF π^-MESON SPECTRA IN THE $K \to 3\pi$ DECAYS. Kapustnikov, A. A. (Leningrad State Univ.). Yadern. Fiz.; 18: No. 6, 1296-1301(Dec 1973). (In Russian).

The strong violation (~35%) of the rule $\Delta T = 1/2$ on the Dalitz plot for the $K \to 3\pi$ decays is considered in the framework of the nonlinear realization of the chiral $SU(2) \times SU(2)$ symmetry. The Lagrangian without derivatives obtained previously is used to describe the contact weak $K\pi$ interaction. It is postulated that the enhancement of effects related to the electromagnetic mass differences of π and K mesons in the $K \to 3\pi$ amplitudes is due to the PCAC modification: $\partial A = \text{constant}\ \pi(1 - 2\alpha\lambda^2\ \overline{KK})$. At $\alpha = 0.8$ the predictions of the model are shown to coincide with the experiment. (auth)

16982 IDENTIFICATION OF PARTON DENSITIES WITH PARTON FRAGMENTATION FUNCTIONS, DUALITY, AND AVERAGE MULTIPLICITIES OF LEPTON–HADRON PROCESSES. Schlereth, H. (Technische Hochschule, Aachen); Rodenberg, R. Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 15, 313-334(1973).

Suggesting that the hadronic and the current densities of quark-partons are identical and utilizing duality principles predictions for the average multiplicities of lepton-hadron processes in the deep inelastic scaling region are derived. (auth)

16983 POMERON IN DEEP INELASTIC LEPTON HADRON SCATTERING. Rodenberg, R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Kim, B. R.; Schlereth, H. Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 12, 221-240(1973).

Within the framework of Harari's conjecture and the constraints provided by duality the consequences of a non-SU(3) singlet Pomeron in deep inelastic lepton–hadron scattering are investigated. The corresponding distribution functions of the quark parton model are discussed. (auth)

Strong (General)

16984 (COO-3285-11) RESEARCH IN THEORETICAL PHYSICS. Annual Report, April 1, 1973–March 31, 1974. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Physics). Dec 1973. Contract AT(11-1)-3285. 21p. Dep. NTIS $3.00.

Research was performed on asymptotic symmetries of hadron dynamics. Asymptotic invariance of hadron dynamics under SU(2,2) transformations is conjectured. A systematic perturbation theory was developed around the asymptotic symmetry limit. A perturbative model of hadronic Regge trajectories was constructed; it leads to almost linear families of Regge trajectories with particle decay widths increasing along the trajectories. Single particle inclusive distributions for large q_T were calculated for $pp \to$ (meson) + X and $ep \to e +$ (meson) + X. The inclusive cross sections obey scaling laws; they possess a parton-like structure automatically. The distribution in the CMS is of the form: $(q_T^2/s)^{-A}(1 - 2|9|/\sqrt{s})^B$, with usual notation of kinematic variables. Substantial heavy particle production is predicted (~30% at ISR energies.) The predictions agree well with available experimental data. A list of publications is presented. (auth)

16985 LIMITING FRAGMENTATION AND BJORKEN SCALING IN A BARYON EXCHANGE MODEL. Ebata, T. (Tohoku Univ., Sendai); Kasahara, T.; Ishikawa, K.; Akiba, T. Progr. Theor. Phys. (Kyoto); 49: No. 6, 2079-2091(Jun 1973).

The target fragmentation in an inclusive reaction is studied in a baryon exchange model. The invariant distribution function expressed by the total cross section of hadron-hadron scattering shows scaling behavior. The calculation is compared with the data. The formalism is also applied to the inclusive reaction by electrons. Possible connection of Bjorken scaling to the limiting fragmentation is discussed. (auth)

16986 FIELD-THEORETIC DESCRIPTION OF UNSTABLE PARTICLES AND RESONANCES. Lukierski, J. (Univ., Wroclaw). Acta Univ. Wratislaviensis; 2: No. 164, 115-145(1972).

Three ways of introducing unstable particles in relativistic QFT are presented. In the conventional method the unstable particle is defined by means of the singularities of Green functions on second Riemann sheet. There are also two ways of introducing unstable particles as elementary objects: by means of the suitably chosen generalized free field or using the field operator satisfying the K–G equation with complex mass. Attention is focused on the method using generalized free field with continuous and integrable Kallen–Lehmann spectral function as describing relativistic QFT of elementary unstable objects. These unstable objects are expressed in terms of their stable decay products, which leads to a new kind of statistics for these decay products. The field operator describing "elementary resonance" and the crossing relations for such operator are briefly discussed. (auth)

16987 RECENT PROGRESS IN THEORIES OF DEEP INELASTIC PHENOMENA. Casher, A. (Tel Aviv Univ., Israel); Kogut, J.; Susskind, L. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 102-119(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Two recently proposed field theoretic mechanisms which may shed light on deep inelastic phenomena are discussed in simple physical terms. Certain gauge theories of quarks can have the short distance and light cone properties of quark fields without their production in scattering experiments. Gauge theories can also be free at short distances and lead to asymptotic Bjorken scaling broken only by logarithms. These proposals suggest non-abelian gauge theories of colored quarks as the field-theoretic basis of strong interactions. (auth)

16988 HADRON SPECTROSCOPY. Rosner, J. L. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 130-155(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Recent experimental and theoretical developments in the field of hadronic resonances are reviewed. (auth)

16989 COMPARISON OF MODELS FOR RESONANCE DECAYS. Kugler, M. (Stanford Linear Accelerator Center, CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 222-229(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Three quark based models for hadron decays are compared. The physical reasons for a similar algebraic structure and for the important differences in some predictions are emphasized. (auth)

16990 PHENOMENOLOGY OF HIGH ENERGY EXCHANGE PROCESSES. Kane, G. L. (Univ. of Michigan, Ann Arbor). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 230-273(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A historical and general survey is given on the basic approaches and models used for studying high energy hadron interactions. A number of current subjects with interesting possibilities or implications are also discussed. These include remarks on amplitude analysis, fixed t zeros, np → pn and $\bar{p}p \to \bar{n}n$ interactions, energy dependence, production of higher spin resonances, and expectations for higher energy data soon to come. (LBS)

16991 WHAT HAVE WE LEARNED FROM HIGH ENERGY EXPERIMENTS. Quigg, C. (State Univ. of New York, Stony Brook). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 520-551(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A survey is given of the lessons to be learned from first-generation strong-interaction experiments at the National Accelerator Laboratory and the CERN Intersecting Storage Rings. A program to study the properties of diffraction dissociation is urged for the NAL bubble chamber experiments. Throughout, the emphasis is placed upon conclusions of a general nature rather than those which depend on details of models. (auth)

16992 ONE DIMENSIONAL MODELS AND WHAT CAN BE LEARNED ABOUT THEM FROM NAL AND ISR DATA. Thomas, G. H. (Argonne National Lab., IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 559-569(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The one dimensional language is employed in the description of some of the data recently available from the NAL and ISR. To illustrate the phenomenological value of such a description, left-right multiplicity data are discussed in some detail. In addition to the more orthodox, a few nonstandard suggestions are made for presenting data based on the one dimensional ideas. (auth)

16993 SURVEY OF DEVELOPMENTS IN STRONG INTERACTION THEORIES. Abarbanel, H. D. I. (National Accelerator Lab., Batavia, IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 570-593(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The discussion of developments in strong interaction theories is limited to three subjects: rising total cross sections and theories which attempt to explain this phenomena; gauge theories of strong interactions and the possible relevance of such field theories to scaling; and dual string models. (LBS)

16994 PERTURBATIVE APPROACH TO HIGH ENERGY MULTIPARTICLE REACTIONS. Frazer, W. R. (Univ. of California, San Diego, La Jolla). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 621-626(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Two-component models have been quite successful in fitting multiplicity distributions in high-energy hadronic collisions. The fact that the diffractive component is considerably smaller than the short-range-correlation component suggests the possibility of a perturbative expansion of the high-energy total cross section. The development of such an expansion is discussed, as well as some of its consequences. (auth)

16995 PARTON MODELS AND DEEP HADRON-HADRON SCATTERING. Savit, R. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 639-649(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A review is given of the recent applications of various parton models to the problem of hadron-hadron scattering at large momentum transfers. Models which allow direct parton-parton interaction as well as those that do not are considered. Predictions for the structure of hadronic final states (whether or not transverse jets exist), associated multiplities, and the s and t dependencies of inclusive and exclusive cross sections are described for the two types of models and compared with available data. The relation of the large momentum transfer (deep) region to the small momentum transfer (Regge) region is also discussed. (auth)

16996 POSSIBLE MEASUREMENT OF THE VELOCITY PROFILE INSIDE A NUCLEUS AND A HADRON. Chou, T. T. (Univ. of Denver). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 118-123 (1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

Utilizing the fact that the opaqueness (or the total cross section) of hadrons increases with incoming energy, a way is proposed by which the velocity profile of the stuff inside a nucleon or an atomic nucleus can be measured. (auth)

16997 REGGE COUPLINGS IN EXCLUSIVE AND INCLUSIVE REACTIONS. Moen, I. O.; Zakrzewski, W. J. (Cambridge Univ., Eng.). Nuovo Cim.; 19A: No. 1, 34-52(1 Jan 1974).

Regge vertices which appear in asymptotic limits of inclusive and exclusive reactions are compared. Some specific models predict their equality, but a general group-theory expansion shows that, in general, these vertices do not have to be equal. Thus decoupling theorems need not hold. (auth)

16998 HADRONIC GEOMETRY OF SPACE-TIME AND GAUGE THEORY OF STRONG INTERACTIONS. I. Heskia, S. (London Univ.). Nuovo Cim; 19A: No. 1, 90-102(1 Jan 1974).

In two papers, of which this is the first, an attempt has been made to link the hadronic geometry of the space-time with the gauge theory of strong interactions. This has been done by postulating a unified hadronic metric tensor $f_{\mu\nu}(X,y)$ of strong gravity and strong electromagnetism and showing that the Christoffel symbol arising from this metric tensor is responsible for nine gauge vector fields $(A_\lambda^{(0)}, B_\lambda^{(a)})$ of gauge group $U_1 \times SU_3$ with U_1 having symmetry-breaking properties. (auth)

16999 HADRONIC GEOMETRY OF SPACE-TIME AND GAUGE THEORY OF STRONG INTERACTIONS. II. Heskia, S. (London Univ.) Nuovo Cim., A; 19: No. 1, 103-117(1 Jan 1974).

The development started in the preceding paper in which a strong (massive) electromagnetic vector field $A_\lambda^{(0)}$ was described in terms of a y-dependent hadronic metric tensor $f_{\mu\nu}(y)$ of the space-time is continued. Strong gravity is introduced and it is shown that the Christoffel symbols arising from $f_{\mu\nu}(X, y)$ lead to the eight additional massive gauge vector fields B_λ^a of gauge group SU_3 with a gauge-invariant Lagrangian. (auth)

17000 ADVANTAGES OF THE COLOR OCTET GLUON PICTURE. Fritzsch, H.; Gell-mann, M.; Leutwyler, H. (California Inst. of Tech., Pasadena). Phys. Lett., 47B: No. 4, 365-368 (26 Nov 1973).

It is pointed out that there are several advantages in abstracting properties of hadrons and their currents from a Yang-Mills gauge model based on colored quarks and color octet gluons. (auth)

17001 PHASE OF THE $\rho-\omega$ MIXING PARAMETER DERIVED FROM THE UNITARITY RELATION. Gien, T. T. (Univ. of Newfoundland, St. John's). Can. J. Phys.; 51: No. 18, 1915-1917(15 Sep 1973).

The phase of the $\rho-\omega$ mixing parameter is calculated in detail from the unitarity relation without considering the so-called superweak hypothesis for the ρ and ω decay. It is found that the result does not differ considerably from the one obtained previously (Gien) with the superweak hypothesis used. (auth)

17002 QUARK QUANTUM NUMBERS IN THE CURRENT FRAGMENTATION REGION. Chaichian, M. (Univ. of Helsinki); Cleymans, J.; Lam, W. S. Phys. Lett.; 47B: No. 5, 460-462 (10 Dec 1973).

The conditions under which constituent quantum numbers can be observed in the current fragmentation region are analyzed. It is assumed that quarks, isolated in phase space, undergo a cascade process thereby producing hadrons in an incoherent way. In addition to SU(3) symmetry for the produced hadrons in the current plateau, it is necessary to have a specific relation between baryon and meson production. In a simple model with short range correlations one should have, roughly, as many baryons as mesons asymptotically in the current plateau. (auth)

17003 FACTORIZATION OF TOTAL CROSS SECTIONS AT HIGH ENERGY. Cardy, J. L.; White, A. R. (CERN, Geneva). Phys. Lett.; 47B: No. 5, 445-448(10 Dec 1973).

It is shown that, within a consistent picture of a Pomeron pole of intercept one which evades the decoupling arguments, total cross sections should factorize in the energy regime where three and more Pomeron cuts are negligible. (auth)

17004 CORRELATION OF IDENTICAL PIONS IN MULTIPLE PRODUCTION REACTIONS. Shuryak, E. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 18: No. 6, 1302-1308(Dec 1973). (In Russian).

The two-body spectra of identical particles show the interference effects which are the direct consequence of quantum statistics. The effects can be used to obtain information on the space-time structure of multiple production reactions. (auth)

Strong (Baryon No. = 0)

17005 (IC-73/150) AXIAL-VECTOR NUCLEON FORM FACTOR AND LOW-ENERGY PION ELECTROPRODUCTION. Furlan, G.; Paver, N.; Verzegnassi, C. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1973. 15p. (CONF-730580-1). Dep. NTIS (U. S. Sales Only) $3.00.

From third experimental triangle seminar on high energy nuclear physics; Trieste, Italy (May 1973).

The recent experiments on π^+ electroproduction at threshold with the predictions obtained using the Fubini and Furlan method are compared. The values obtained for $G_A(0)$ range from $6m_\pi$ to $8m_\pi$. (auth)

17006 (ORO-3992-78) CHARGE EXCHANGE AND HYPERCHARGE EXCHANGE PROCESSES IN THE $[U(6) \times U(6)]_S$ ALGEBRA OF HADRON STRENGTHS. Ne'eman, Y.; Reddy, V. T. N. (Texas Univ., Austin (USA). Center for Particle Theory). 1972. 8p. (CPT-132). Dep. NTIS $3.00.

The predictions of the $[U(6) \times U(6)]_S$ algebra of hadron strengths for the near forward differential scattering cross sections in charge exchange and hypercharge exchange processes are reported and some of them compared with experiment. A comment is made on the covariance of the formalism. (auth)

17007 (RL-73-130) SIMPLE LOWER BOUND FOR THE $\pi^0\pi^0$ TOTAL CROSS-SECTION. Palou, F. P. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Nov 1973. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

A lower bound is obtained to the s-wave contribution (and, a fortiori, to the total contribution) to the energy-averaged $\pi^0\pi^0$ total cross section which depends only on a physical low energy parameter. The bound is only a few times smaller than the estimated value of the averages. (auth)

17008 CALCULATION OF THE COUPLINGS OF THE ρ AND A_2 BASED ON THE FACTORIZATION OF THE RESIDUES IN THE REGGE MODEL. Santoro, A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 7, 119-141(1973). (In French).

The coupling constants $g^{\pm}_{\rho NN}$, $g_{\rho NN}$, $g^{\pm}_{A_2 NN}$, and $g_{A_2 NN}$ were calculated using in a systematic way the factorization of residues in a

modified Regge model. Other coupling constants were calculated starting from the total or partial widths of the resonances. A posteriori on the whole good agreement with experiment was obtained for the differential and total cross sections for the systems πN, KN, and NN. This study also shows as a hypothesis that the residues of Regge poles are approximately constant in momentum transfer, for a fixed scale factor of 1 GeV^2, are compatible with experiment. (tr-auth)

17009 R-S-T-U MASS REGION. Smith, G. A. (Michigan State Univ., East Lansing). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 163-187(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Contributed papers to the session on hadronic spectroscopy are reviewed. The relationship of these contributions to existing knowledge on the R-S-T-U meson states is discussed. (auth)

17010 BEYOND THE RISING TOTAL CROSS SECTIONS. Wu, T. T. (Harvard Univ., Cambridge, MA); Cheng, H. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 54-97(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

The theoretical reasoning that leads to the prediction of, among others, total cross section rising like (ln s)^2 is reviewed. Briefly, relativistic kinematics dictate the dependence on longitudinal momentum of particles produced in pionization region, and leads to a factor of ln s in the integrated cross section. Unitarity in the t-channel them amplifies this ln s to be a power of s, divided possibly by a power of ln s. This power of s is a realization of the strongly absorptive potential with a coupling constant increasing with energy, and thus the Froissart bound for total cross sections is saturated. Many other results, concerning in particular the phases of the scattering amplitudes in the forward direction and differential cross sections for both elastic and inelastic diffractive scattering, are obtained at the same time. In order to make quantitative comparison with experimental data, past and future, a simple model of hadron scattering is described. When applied to the elastic scattering of pp, $\bar{p}$p, π^+p, and K$^+$p, this model describes reasonably well existing data beyond 20 GeV. From the resulting parameters, quantitative predictions about these processes are given in detail up to the highest energy that may become available from accelerators in this century, namely 1.5 TeV on 1.5 TeV. These considerations are also extended to inelastic diffractive scattering without spin-parity exchange. A number of problems related to increasing total cross sections, some unsolved, are discussed. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 17330, 17340, and 17373.

17011 (COO-1195-269) DECK MODEL CALCULATION OF $\pi^-p \to \pi^-\pi^+\pi^-p$. Ascoli, G.; Cutler, R.; Jones, L. M.; Kruse, U.; Roberts, T.; Weinstein, B.; Wyld, H. W. Jr. (Illinois Univ., Urbana (USA). Dept. of Physics). Aug 1973. Contract AT(11-1)-1195. 57p. Dep. NTIS $5.00.

A Deck-like model for the reaction $\pi^-p \to \pi^-\pi^+\pi^-p$ is formulated and studied. The model differs from previous Deck calculations in two respects: i) experimental data are used for both ππ and πN scattering, and ii) the amplitude has proper Bose symmetry. Feature i) allows one to examine any desired region of 3π mass (the A_3 is treated on the same footing as the A_1); features i) and ii) allow one to examine all the angular dependence in the final state and to compare with partial wave analyses of experimental data. The results of a study are presented in which events generated from the model by a Monte Carlo method are plotted and fit in the same way as experimental events. Many of the features of the data are qualitatively reproduced including certain important properties obtained from the partial wave analysis in the A_1 region. The A_3 region is not accurately represented by the model. (auth)

17012 (LA-5443-C, pp 226-236) HARD MESON CURRENT ALGEBRA AMPLITUDES FOR PION–NUCLEON SCATTERING. Nath, P. (Northeastern Univ., Boston); Kere, S. S. Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

Pion–nucleon scattering in the low and intermediate energy region (up to 500 MeV above threshold) is determined using the hard meson current algebra method. The method is based on Gell-Mann's SU(2) × SU(2) equal time current commutation relations, the conserved vector current hypothesis, i.e., the CVC condition, the partially conserved axial vector current hypothesis, i.e., the PCAC condition and single partial saturation of intermediate states by low-lying meson and nucleon resonances. The current algebra evaluations of the S-wave scattering lengths $a_S^\pm$ of S-wave effective ranges $b_S^\pm$ and P-wave scattering lengths $a_P^\pm$ are given and compared with all the existing experiment. Unitarization of the current algebra amplitudes allows the determination of the phase shifts and inelasticities in the S_{11}, S_{31}, P_{11}, P_{31}, P_{13}, and P_{33} channels up to 500 MeV above threshold. Excellent agreement with experiment occurs in all the channels analyzed. Extension of the techniques for analysis of higher partial waves is given. Possible future applications of off-the-mass shell amplitudes predicted by current algebra as inputs in other calculations are discussed. (auth)

17013 (RLO-2041-99) MULTIPLICITY SCALING IN THE NUMBER OF NEGATIVE SECONDARIES. Aubrecht, G. J. II; Gordon, E. M. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1973. Contract AT(45-1)-2230. 7p. Dep. NTIS $3.00.

It is suggested that Koba-Nielsen-Olesen scaling may occur in the n_{-}, the number of negative secondary particles. Scaling in this variable implies that $\langle n_{ch}\rangle/D_{ch}$ slowly decreases to its asymptotic value as the energy increases. (auth)

17014 RELATIVISTIC PARAMETRIZATION OF THE P'_{33} RESONANCE IN PION–NUCLEON SCATTERING. Tschang, Y. P. Gainesville, FL; Univ. of Florida (1972). 73p. University Microfilms Order No. 73-29,218.

Thesis (Ph. D.).

A relativistic generalization of the Breit-Wigner formula is further improved and applied to the study of the P'_{33} resonance in pion-nucleon scattering. Reasonable fits with the P_{33} phase shift data are obtained. The new parametrization reduces to a simple Breit-Wigner form in the neighborhood of a resonance. Away from the resonance, however, the new parametrization was seen to be far superior to the Breit-Wigner formula. This parametrization opens up a possible way of attacking the problem of hadron dynamics. In addition, values of the coupling constants $C_{\pi N'\Delta}$ and $C_{\pi\Delta\Delta}$ are predicted by this parametrization from phase shift fits. (Diss. Abstr. Int., B)

17015 πN-SCATTERING AT HIGH ENERGIES IN THE QUASIPOTENTIAL APPROACH. Dzhgarkava, M. I.; Garsevanishvili, V. R.; Goloskokov, S. V.; Kazarinov, Yu. M.; Matveev, V. A.; Potashnikova, I. K.; Silin, I. N.; Slepchenko, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., B67: No. 1, 232-259(1973).

Experimental data on πN scattering in the momentum transfer region $0.01 \leq |t| \leq 1.0$ (GeV/c)^2 and $P_L \gtrsim 10$ GeV/c are described in the framework of the quasipotential approach. The parameters of the quasipotential are found which allow the data to be described satisfactorily. (auth)

17016 CLASSIFICATION OF THE BARYONS. Kalman, C. S. (Loyola of Montreal). Particles Nucl.; 5: No. 5-6, 183-190(1973).

A new mass sum rule and a recently proposed mass formula are used to classify the baryons. The $J^P = \frac{1}{2}^-$ and $\frac{3}{2}^-$ are each organized into three octets distinguished by a single new quantum number. A $J^P = \frac{1}{2}^-\Lambda$ is predicted at roughly 1530 MeV and $J^P = \frac{3}{2}^-\Sigma$ at roughly 1500 MeV. Several other $J^P = \frac{3}{2}^-$ baryon resonances are also predicted at higher energies. The observed Λ'' at 2110 MeV is predicted to have $J^P = \frac{5}{2}^+$ and assigned to a new octet. Finally the present assignment of $J^P = \frac{5}{2}^-$ octet is placed in doubt. (auth)

17017 NEW PHENOMENA IN πN → πN: SATURATION OF THE MOST STRINGENT ISOSPIN BOUND. Toernqvist, N. A. (Univ. of Helsinki). Phys. Lett.; 47B: No. 5, 449-452(10 Dec 1973).

The most stringent isospin bound for πN → πN must be saturated along certain lines in the s–t plane. These lines correspond to zeros of the imaginary part of a bilinear combination of the amplitudes and impose strong constraints on data and amplitude analyses. For $t \leq -1$ GeV/c the bound is always nearly saturated for the energies below 2 GeV/c where this analysis was done. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 17353.

17018 (RLO-1388-666) REGGEON CALCULUS VIEW OF DIFFRACTION SCATTERING. Ng, J. N. (Washington Univ., Seattle (USA)). 1973. 13p. (CONF-730837-12). Dep. NTIS $3.00.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

Gribov's theory of the Pomeranchon is briefly reviewed. It is then demonstrated that the recent observed use in proton-proton total cross section at CERN ISR and the various structures in the elastic cross section can be simultaneously explained within the framework of this theory. (auth)

17019 PRODUCTION OF S-WAVE PIONS IN THRESHOLD $p + p \rightarrow \pi + d$. Pradhan, H. C.; Singh, Y. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 3, 343-351(1 Feb 1973).

Using a number of nonlocal, two-term, separable, nucleon-nucleon interactions and their phase-equivalent transforms, it is shown that the production of s-wave pions near the threshold in the reaction $p + p \rightarrow \pi^+ + d$ is sensitive, not only to the D-state probability of the deuteron and the nonlocality of the interaction, but also to the off-shell behavior of the interaction. The reaction, therefore, cannot serve, in the context of simple two-term separable potentials, as an effective criterion to constrain the value of the D-state probability of the deuteron to better than the present range of 3 to 8%. Results are presented also for Reid soft-core local interaction where it is found that the off-shell effects are constrained by the deuteron form factor. (auth)

17020 INELASTIC SCATTERING AMPLITUDES. Matthews, J. A. J. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 274-280(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

New results from inelastic two-body scattering reactions are reviewed. Although predictions of SU(3), factorization and simple Regge theory are found to be qualitatively in agreement with the data, direct channel or absorption effects afford the simplest interpretation of the detailed features of the scattering amplitudes. (auth)

17021 INCLUSIVE EXPERIMENTS AT ISR-ENERGIES. Boeggild, H. (Univ. of Copenhagen). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 417-463(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

A brief note is given on the ISR, what it can and cannot do. The single particle inclusive spectra are discussed in terms of scaling, approach to scaling, limiting fragmentation, central rapidity plateau, particle composition, etc. Events having particles of very high transverse momenta are next discussed. Finally, some very recent results concerning associated multiplicities and charge distributions in the central region are discussed. (LBS)

17022 SOME OFF-BEAT ASPECTS OF PROTON-PROTON PRODUCTION PROCESSES. Sivers, D. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 552-558(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Four aspects of the phenomenology of high energy production processes are discussed: the approach to scaling, the relation between inclusive cross-sections and total cross-sections, the rapidity charge density, and left-right multiplicity distributions. The goal of the discussion is to provide a slightly different slant on important features of the data. (auth)

17023 REGGEON CALCULUS VIEW OF DIFFRACTION SCATTERING. Ng, J. N. (Univ. of Washington, Seattle). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 608-620(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

Gribov's theory of the Pomeranchon is briefly reviewed. It is then demonstrated that the recent observed rise in proton-proton total cross section at CERN ISR and the various structures in the elastic cross section can be simultaneously explained within the framework of this theory. (auth)

17024 EFFECT OF $\Lambda\Sigma$ CONVERSION ON THE Λ PARTICLE BINDING ENERGY IN NUCLEAR MATTER. Dabrowski, J. (McMaster Univ., Hamilton, Ont.). Phys. Lett., 47B: No. 4, 306-310(26 Nov 1973).

The Λ particle binding energy in nuclear matter is calculated with a phenomenological separable $\Lambda N - \Sigma N$ potential matrix and with a separable NN potential. The calculation includes the three-body ΛNN cluster energy and the rearrangement energy, both of which give only relatively small contributions to the calculated substantial Σ suppression. (auth)

17025 NEUTRON-DEUTERON SCATTERING IN HIGH PARTIAL WAVES. Fuda, M. G. (State Univ. of New York, Buffalo). Phys. Lett., 47B: No. 4, 288-290(26 Nov 1973).

A simple formula is derived for calculating the n + d phase shifts for states with high relative orbital angular momentum. The only parameters appearing in the formula are the deuteron binding energy and the triplet effective range. The formula is tested by comparing it with the results of an exactly solvable model, and it is found to be quite accurate at low energies for $L \geq 3$. (auth)

17026 INTRODUCTORY REMARKS TO A DISCUSSION ON RISING CROSS SECTIONS. Amaldi, U. (CERN, Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 47-52(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

The information obtained in the last two years on high energy proton-proton elastic scattering is summarized. Then the implications on the impact parameter description of proton-proton collisions and on the inelastic mechanism which drives the rise of the total cross section are briefly outlined. (auth)

17027 INCLUSIVE STRUCTURE OF DIFFRACTION SCATTERING. Fox, G. C. (California Inst. of Tech., Pasadena). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 15, 180-231(1973).

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973). See CONF-730841-.

Triple Regge predictions for diffractive proton events ($pp \rightarrow p +$ anything) are reviewed. The data appears to be in splendid agreement with this formalism but is as yet too pauce to allow quantitative fits. The published analyses make simplifying assumptions which are not justified by theory and/or experiment. The inclusive properties of the other particles produced in diffractive proton events disagree with fragmentation (nova) model predictions but appear very consistent with the multiperipheral suggestion that Pomeron-proton scattering has similar inclusive structure to proton-proton scattering. (auth)

17028 EVIDENCE FOR CRITICAL POINT EFFECTS IN HIGH ENERGY PARTICLE MULTIPLICITIES. Arnold, R. C.; Thomas, G. H. (Argonne National Lab., IL). Phys. Lett., 47B: No. 4, 371-373(26 Nov 1973).

Starting from the gas-liquid analog, a theory for charged particle multiplicities is proposed which allows for both short and long range interactions. Based on the assumptions that at infinite energy, (1) the elementary particle fluid is at a critical point, (2) the basic exchange for the inelastic two prong cross section is dominated by $\alpha(0) = \frac{1}{2}$, and (3) the total inelastic cross section is constant up to factors of ln s, a no-parameter phenomenological theory is obtained and compared to recent very high energy data. Strong support is found for an approach to the predicted limit. (auth)

17029 EFFECTIVE INTERACTION FOR PION ABSORPTION AND PRODUCTION BY TWO NUCLEONS AT LOW ENERGIES. Cheon, I. T.; Cugnon, J. (Univ., Liege). Nucl. Phys., B66: 412-428(1973).

An effective interaction which can be applied to the problems of pion absorption and production at low energy is proposed in an elegant form. This effective interaction includes the pion rescattering effects which are very important in the absorption and production processes. The interaction proposed here is examined under consideration of the Coulomb effects in the process $\pi^+ + d \rightarrow p + p$ at very low energies. The determination of the scattering lengths is attempted. For $a_1 - a_3 = 0.291$ the best fit is $a_1 - a_3 = -0.555$. The absorption rate of a pion by a deuteron from the atomic 1S state is also calculated. The result is $W = 1.10 \times 10^{16}$ sec^{-1}. It should be stressed that our theory includes no free parameter. (auth)

17030 SPINOR-SPINOR BETHE-SALPETER EQUATION IN THE COHEN APPROXIMATION. Noble, C. J.; Richards, K. C. (Franklin Inst., Swarthmore, PA). Phys. Lett., 47B: No. 4, 319-321(26 Nov 1973).

The Cohen approximation was applied to the spinor-spinor Bethe-Salpeter equation. Phase shifts for the $^1S_0$ and $^3P_0$ channels were obtained and compared with those of exact calculations. Major features of these exact solutions are reproduced by the Cohen approximation. (auth)

17031 PRODUCTION OF HYPERNUCLEI USING FAST KAONS. Esch, R. J. (Oxford Univ.). Can. J. Phys.; 51: No. 14, 1524-1533(15 Jul 1973).

The differential cross sections for the production of definite lambda hypernuclear states are calculated for the reaction $n(K^-,\pi^-)\Lambda^0$ on nuclear targets of helium, carbon, and oxygen at incident momenta from 500 to 800 MeV/c. A direct interaction model is used, employing the single scattering, impulse approximation. It is shown that these predictions are very sensitive to the three-momentum transfer and to the wave function of the bound lambda in the hypernucleus. Possible experimental consequences are discussed concerning the observation of hypernucleus production by studying the missing mass spectrum of the emitted pion. (auth)

17032 SOME REMARKS CONCERNING K^0_S AND Λ PRODUCTION IN HIGH ENERGY PROTON-PROTON COLLISIONS. Cohen, D. (Univ. of Rochester, NY). Phys. Lett.; 47B: No. 5, 457-459(10 Dec 1973).

It is observed that the topological cross sections for K^0_S and Λ production in high energy proton-proton collisions can be parametrized within the framework of the KNO semi-inclusive scaling prediction in the same manner as the charged-particle and π^0

topological cross sections. It is also noted that the $K^0_S\pi^-$ and $\Lambda\pi^-$ correlations seem to exhibit a weaker energy dependence than the $\pi^0\pi^-$ correlations over a range of beam momenta extending from 69 GeV/c to 303 GeV/c. (auth)

17033 PION–DEUTERON SCATTERING WITH A SPIN AT MODERATE ENERGIES. Karmanov, V. A. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 18: No. 6, 1213-1222(Dec 1973). (In Russian).

The method is developed to calculate the πd amplitude at the pion energies $T_\pi \sim 100$ MeV taking into account the spin and isospin of the particles involved as well as the rescatterings of all orders. The πd-scattering cross section and polarization moments of the deuteron are obtained. The πd-scattering amplitude is expressed through a subsidiary quantity which is the isobar-nucleon scattering amplitude. In turn, the latter is written in terms of the πN partial amplitudes. The transition to the coordinate representation for the isobar-nucleon invariant amplitudes leads to a system of linear algebraic equations. In the Δ-resonance region the number of the coupled equations in the system is equal to three. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 17492.

17034 CONFORMAL INVARIANCE. Niederle, J. (Inst. of Physics, Prague). Acta Univ. Wratislaviensis; 2: No. 164, 44-65 (1972).

The properties and applications of the conformal group are reviewed. The use of conformal groups in physics, conformal covariance of field equations, Poincare and conformal covariance, Weyl and conformal covariance, and the scaling law are covered. (JFP)

17035 MEANING OF TIME REVERSAL INVARIANCE VIOLATION. Van der Merwe, P. du T. (Atomic Energy Board, Pretoria). Z. Naturforsch., 28a: No. 1, 57-59(Jan 1973).

The possible effect of a cosmological background (such as proton-neutron preponderance) on the meaning of time-reversal violation is discussed in the context of the Duerr-Heisenberg degenerate vacuum theory of strangeness. (auth)

Applications (Electromagnetic and Weak)

17036 SEARCH FOR THE CP VIOLATION IN THE $K^0 \to 3\pi^0$ DECAYS. Barmin, V. V.; Barylov, V. G.; Davidenko, G. V.; Demidov, V. S.; Dolgolenko, A. G.; Zombkovskaya, N. K.; Matveev, V. A.; Meshkovskii, A. G.; Mirosidi, G. S.; Novikov, L. S.; Chistyakova, T. A.; Chuvilo, I. V.; Shebanov, V. A.; Shishov, N. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 6, 1232-1235(Dec 1973). (In Russian).

The time-of-flight distribution of 22 events of the $K^0 \to 3\pi^0$ decay was studied by means of the ITEP 180-litre xenon bubble chamber. The ratio η_{000} of the amplitudes of the decays $K_S \to 3\pi^0$ and $K_L \to 3\pi^0$ was found to be $\mathrm{Re}\ \eta_{000} = -0.04 \pm 0.45$ and $\mathrm{Im}\ \eta_{000} = 0.45^{+0.10}_{-0.08}$. Under the assumption of the CPT invariance $|\eta_{000}|^2 \leq 1.2$ and $\Gamma(K_S \to 3\pi^0)/\Gamma(K_S) \leq 4.3 \cdot 10^{-4}$ at 90% confidence level. (auth)

Applications (Strong)

17037 (ORO-3992-153) SPECTRAL SUM RULES BASED ON THE WILSON EXPANSION IN THE $(3,\bar{3}) + (\bar{3},3)$ MODEL OF CHIRAL SYMMETRY. Auvil, P. R.; Deshpande, N. G. (Texas Univ., Austin (USA). Center For Particle Theory). 1973. Contract AT(40-1)-3992. 7p. (CPT-198). Dep. NTIS $3.00.

A new set of sum rules relating symmetry breaking parameters in the pseudoscalar meson sector is derived. These results combined with previously derived sum rules completely determine the symmetry breaking parameters. Good agreement with K_{l3} results is obtained along with predictions of $\Gamma(\eta' \to 2\gamma)$ and $\Gamma(\eta' \to 3\pi)$ which are consistent with experiment. (auth)

17038 (ORO-3992-160) CHIRAL SU(4) × SU(4) AND THE DECAY $X \to n\pi\pi$. Deshpande, N. G.; Dicus, D. A. (Texas Univ., Austin (USA). Center for Particle Theory). 1973. Contract AT(40-1)-3992. 14p. (CPT-204). Dep. NTIS $3.00.

We calculate the decay rate for the process $X \to \eta\pi\pi$ in a chiral SU(4) ⊗ SU(4) model. The presence of two I = 0, Y = 0 Goldstone particles in the symmetry limit allows us to extend PCAC to both η and X fields. The rate is calculated purely in terms of the symmetry breaking parameters of the model, under the assumption tha the symmetry is broken by $(4^*,4) \oplus (4,4^*)$ representation. It is found that the calculated rate is well below the expected experimental rate for reasonable values of the symmetry breaking parameters. (auth)

17039 BROKEN CONFORMAL SYMMETRY AND HADRONIC SCALING. Yunn, B. C. Baltimore; Johns Hopkins Univ. (1973). 105p. University Microfilms Order No. 73-28,446.

Thesis (Ph. D.).

High energy, large momentum transfer hadronic reactions are studied in the framework of a broken conformal symmetry. In the conformal symmetry limit, hadrons are assigned phenomenological fields which belong to infinite dimensional irreducible representations of a pseudo unitary group SU(2,2), which is homomorphic to the conformal group, and also their effective action is conformal invariant. Studying simple Lagrangian models, it is conjectured that the conformal symmetry is spontaneously broken and also that the scalar field χ (the Goldstone boson), which has nonvanishing vacuum expectation value, has a scale dimension $d = -2 + 2\delta$ where δ represents deviation from the canonical dimension. Then the inverse propagator is calculated up to and including the first order in the tadpole expansion explicitly and it is found that hadrons lie on almost linear Regge trajectories, which are determined by regular null surfaces of the inverse propagator. The widths of resonances are connected to the anomalous part of the dimension, δ. Empirical fit with the data (baryon resonances) gives $\delta \sim 0.04$. In this framework inclusive reactions of the type $p_1 + p_2 \to q + X$ in regions of high transverse momenta are also studied. On studying the absorptive part of the six-point conformal amplitude, it is found that the inclusive cross sections scale roughly as $\sim S^{-2}(S/q_T^2)^4$, thereby recovering the form suggested by Cline, Halzen and Waldrop. Also large rates of heavy particle production are predicted. (Diss. Abstr. Int., B)

17040 SU(1,3) AS A DYNAMICAL GROUP: ANALYSIS OF ALL THE DISCRETE REPRESENTATIONS. Kalman, C. S. (Loyola of Montreal). Can. J. Phys.; 51: No. 14, 1573-1576 (15 Jul 1973).

A method using the most degenerate representation of SU(1,3) as a dynamical group for the strong interactions of the spin $\frac{1}{2}^+$ baryons is extended to consider all the discrete representations. It is shown that physical conditions place very severe restrictions on the parameters characterizing such a representation. (auth)

Scattering Theory

17041 PROPER TIME FORMULATION OF THE BOUND STATE PROBLEM AND MODELS WITH LINEAR TRAJECTORIES. Montvay, I. (Eoetvoes Univ., Budapest). Acta Univ. Wratislaviensis; 2: No. 164, 98-114(1972).

The notion of relativistic potential is discussed in the classical and quantum mechanical framework. It is shown how second quantization and harmonic oscillator type potentials lead to known models with linear trajectories. (auth)

17042 MULTILINEAR LORENTZ INVARIANT FUNCTIONS AT THE PHYSICAL POINTS. Montvay, I. (Eoetvoes Univ., Budapest). Acta Univ. Wratislaviensis; 2: No. 164, 91-97(1972).

The "fully reggeized scattering amplitudes" of Domokos, Kovesi–Domokos and Schonberg are investigated near the physical points, and another regularization is proposed. (auth)

17043 SELF ENERGY DIFFERENTIAL FORMALISM. Cunningham, J. (University Coll. of North Wales, Bangor, Eng.). Acta Phys. Acad. Sci. Hung.; 34: No. 1, 105-109(1973).

The differential approach to perturbative collision amplitudes is adapted to treat the self energy diagram so providing a differential model for Feynman diagrams with logarithmic integrands. (auth)

17044 REMARK TO THE PROBLEM OF EIGENVALUES OF SCHROEDINGER EQUATION. Ulehla, I. (Charles Univ., Prague); Wiesner, J. Apl. Mat.; 15: No. 5, 352-355(1970).

For a given potential, obtained from the inverse problem of the scattering theory, an effective and quick method of finding a number of bound states is described. The theorem concerning a number of eigenvalues of the Schroedinger equation is utilized provided the condition $\int_0^\infty x/V(x)/dx < \infty$ is fulfilled. Firstly, the problem is solved analytically for the square well potential; by means of the transformation of the Schroedinger equation to the form $y'(x) = (-V(x)/\lambda)\sin^2(\lambda x + y)$ it is shown that the number of bound states can also be easily obtained by numerical computation. (Nucl. Sci. Abstr. Czech.) (auth)

17045 COMMENT ON A PAPER OF AMREIN, MARTIN, AND MISRA. Zachary, W. W. (Naval Research Lab., Washington, DC). Helv. Phys. Acta; 46: No. 3, 327-330(1973).

A gap in the proof of a proposition in a paper of Amrein, Martin and Misra is pointed out, and proof of their result is given. (auth)

17046 IMPACT PARAMETER REPRESENTATIONS FROM THE POINT OF VIEW OF THE POINCARE GROUP. Andrianov, A. A. (Leningrad State Univ.). Teor. Mat. Fiz.; 17: No. 3, 407-421(Dec 1973). (In Russian).

The impact parameter representations for two-particle scattering amplitude are deduced by means of an expansion of two-particle state on groups isomorphic to the group of motions of the E(2)-plane. Infinitesimal generators of these groups are expressed in terms of total angular momentum and relative momentum operators. As a result the impact parameter operator and the states of two particles with fixed impact parameter are well defined in terms of the Poincare group. (auth)

17047 EIKONAL APPROACH TO HIGH ENERGY SCATTERING. Sugar, R. L. (Univ. of California, Santa Barbara). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 14, 594-607(1973).

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973). See CONF-730837-.

The eikonal approach to high energy scattering and particle production is reviewed. The energy dependence of the eikonal phase is discussed. The effect of the fragmentation of the incident particles on the energy dependence of cross sections is considered. It is pointed out that the opening of diffractive channels leads to a decrease in the total cross section for a wide class of Feynman diagram models. (auth)

17048 POLARIZATION IN TWO-BODY SCATTERING WITH SEPARABLE POTENTIALS. Bhatt, S. C. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 12, 1276-1277(15 Jun 1973).

From the Lippmann–Schwinger equation, a full two-body T matrix in a closed form is obtained for a rank one separable potential. Using the Wolfenstein form for the scattering matrix for the scattering two spin-½ particles Wolfenstein parameters are obtained in terms of the form factors for a one term separable potential. If both incoming particles are unpolarized, the polarization of one of the outgoing particles is found to be identically zero in spite of the inclusion of tensor forces in the separable potential of rank one. (auth)

17049 STRUCTURAL PROPERTIES AND FINITE RANGE ELEMENTARY SOLUTIONS OF THE LINEAR BOLTZMANN EQUATION. Syros, C. (Commission of the European Communities, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 59: No. 6, 500-518(1973).

The natural solutions of the time- and energy-independent linear Boltzmann equation with isotropic scattering were found on $A \otimes B^c$ where A is the interval [a,b] a,b > 0 and $B^c = [-1,0[\cup]0,1]$. These functions are regular everywhere on $A \otimes B^c$ and they satisfy homogeneous or inhomogeneous boundary conditions. The solutions become uniformly continuous functions on $A \otimes B$ and have bounded derivatives of any order if the convention for taking limits, $\lim_{x\to b}\lim_{z\to 0}\psi(x,z)$, is used. The construction of the solutions is based on a number of structural properties established by corresponding new theorems. They exhibit invariance properties with respect to translation, parity, and scaling transformations. (auth)

17050 GENERALIZED GREEN FUNCTIONS. Niemczyk, S. J. (Michigan State Univ., East Lansing). Chem. Phys. Lett.; 23: No. 2, 292-296(15 Nov 1973).

A partial-wave expansion in terms of Jost functions is obtained for the single-particle generalized Green function. Each partial-wave generalized Green function so obtained is in closed form. The results apply at least to Jost function treatable potentials. (auth)

17051 POMERON PROPAGATOR IN POSITRON SPACE. Minami, M. (Kyoto Univ.). Nuovo Cim., 19A: No. 1, 13-33 (1 Jan 1974).

A wave-mechanical description is given of the geometrical properties which underlie the so-called (nonplanar, orientable) one-loop amplitude in dual-resonance models. The description is made in such a way that the amplitude appears as an extension of the conventional Feynman propagator, hence being regarded as a "pomeron" propagator. As an incidental result, the Virasoro condition for one-loop amplitudes is obtained as well as its geometrical implication. (auth)

17052 SCATTERING BY TWO IMPENETRABLE SPHERES. Razavy, M. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 17, 1850-1860(1 Sep 1973).

The problem of multiple scattering by two rigid spheres is studied in the context of an effective range theory. At low energies, by expanding the total wave function in powers of the momentum of the incident particle, it is observed that the coefficients of different terms of the expansion are solutions of either Laplace or Poisson equations. These equations are separable in bispherical coordinates. Using the method of separation of variables, one can determine the scattering amplitude and its first and second derivatives with respect to momentum, at zero energy. In particular, a simple expression is obtained for the scattering length of two hard spheres. With the help of the Green's function in bispherical coordinates, it is shown that for any wave number, the scattered wave satisfies an inhomogeneous integral equation in two variables. Hence, the exact wave function and the scattering amplitude can be found numerically for all energies. (auth)

17053 UNIFIED SPACE–TIME TRIGONOMETRY AND ITS APPLICATIONS TO RELATIVISTIC KINEMATICS. Jaccarini, A. (Laval Univ., Quebec). Can. J. Phys.; 51: No. 12, 1304-1312 (15 Jun 1973).

A geometrical approach to relativistic kinematics is presented. Owing to a unified space-time trigonometry, the spherical trigonometry formalism may be used to describe and study the kinematics of any collision process. Lorentz transformations may thus be treated as purely geometrical problems. A different way to define a unified trigonometry is also proposed, which is based on the spinor representation of the Lorentz group. This leads to a different and more general formalism than the former one. (auth)

17054 MULTIPLE SCATTERING BY TWO CENTERS OF FORCE. Gauthier, L.; Razavy, M. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 12, 1322-1334(15 Jun 1973).

A solvable model for scattering by two centers of force is studied. The force at each center is assumed to be a separable force acting on the S wave only. A force law of this kind enables one to find the scattering amplitude for overlapping as well as nonoverlapping potentials analytically. The resulting scattering amplitudes can be used to compare the range of validity of the Born and other high energy approximations and also to test the accuracy of the result obtained by retaining the leading terms in the multiple scattering series. By examining the relation between the exact scattering amplitude for the two centers and the scattering amplitude of one center, it is shown that in the case of nonoverlapping potentials, the former amplitude can be expressed completely in terms of the latter. Hence no additional information about the nature of force results from the determination of the two-center scattering amplitude. However, for overlapping potentials, one can discriminate among equivalent potentials by finding the scattering amplitude for the two-center-of-force problem. Finally to justify the use of a potential which acts only in one partial wave ($l = 0$), the following observation was made. If one calculates the scattering length for two nonoverlapping hard sphere interactions, using S-wave scattering by each center, and then repeats the calculation for the same interactions, but considers S and P waves and their interference, the difference between the two results will be quite small. (auth)

17055 GENERALIZED WRONSKIAN THEOREM AND INTEGRAL REPRESENTATIONS FOR PHASE SHIFT DIFFERENCES. Moraal, H. (Univ., Cologne). Phys. Lett., 46A: No. 1, 71-72 (19 Nov 1973).

A generalized Wronskian theorem is proved and applied to the partial wave equations of quantum scattering theory. Integral representations for phase shift differences are derived. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 17963.

17056 (COO-1574-33) HELIUM II FILM TRANSFER RATES FOR SOLID-ARGON BEAKERS. Milbrodt, T. O. (Michigan State Univ., East Lansing (USA). Dept. of Physics). 1973. 66p. Dep. NTIS $5.50.

Thesis.

Helium II film transfer rates were measured for filling and for emptying beakers of solid argon. Liquid argon was frozen slowly in a mold which was later removed, leaving free-standing, transparent solid-argon beakers. The beakers used were of 3 mm ID, 5 mm OD, and 3.5 cm in height. Experiments were carried out in the temperature range 1.45 to 2.0 K. The dependence of the transfer rate σ (cm^3/sec-cm of circumference) on the difference between the inner and outer helium levels Z, height of the beaker lip above the level of the liquid source H, and temperature, were studied. The transfer rates were lower than those observed with glass beakers, in agreement with theory. For beaker fillings with a level difference of 1 mm and at a temperature of 1.66 K, the measured transfer rates may be described by the relation $\sigma = 4.8\ H^{-0.21} \times 10^{-5}$ cm^2/sec, where H is in cm. (auth)

17057 GALILEI INVARIANCE AND SUPERFLUIDITY. II. Sen, R. N. (Technion–Israel Inst. of Tech., Haifa). Int. J. Theor. Phys.; 8: No. 4, 277-282(1973).

Following the previous heuristic analysis of the mathematical structure of the Landau excitations (Sen and Zahavi, Physica's Gravenhage; 59: 379(1972)), it is found that in one dimension they may be described by a vector bundle over the base space of the boosts. The total space is a direct integral of all irreducible representations (of a given class) of the Galilei group. The existence of an energy–momentum spectrum requires the action of the boosts to be nonlinear. This action can also be formulated as a superselection rule. (auth)

17058 EVIDENCE FOR ROTON CREATION IN A SUPERFLUID FIELD EMISSION DIODE NEAR 0.5K. Phillips, A.; McClintock, P. V. E. (Univ. of Lancaster, Eng.). Phys. Lett., 46A: No. 2, 109-110(3 Dec 1973).

The field emission current in He II near 0.5 K is found to increase rapidly with pressure above 10 bar. It is suggested this may be because an increasing fraction of the current is being carried by ions moving at the Landau critical velocity. (auth)

17059 SUPERFLUIDITY IN LIQUID ^{3}He. Condensation in the L = 2 or L = State. Oestgaard, E. (Trondheim Univ., Norway). Phys. Lett., 46A: No. 2, 103-104(3 Dec 1973).

The possibility of superfluidity in liquid ^{3}He is investigated, and the corresponding critical temperature is estimated. In the calculations are used reaction-matrix elements calculated earlier by means of Brueckner theory. The results indicate D-state or F-state pairing. The largest transition temperature is obtained for L = 3, i.e., superfluidity corresponding to the triplet F-state seems to be more likely than the singlet D-state pairing predicted earlier. (auth)

17060 SEARCH FOR SECOND-TO-FIRST-SOUND COUPLING IN ROTATING LIQUID HELIUM. Lucas, P. (Univ. of Manchester, Eng.). J. Phys., C (London); 6: No. 23, 3372-3384(27 Nov 1973).

Hall's (J. Phys. C: Solid State Phys.; 3:1166-79 (1970)) prediction that first sound will be generated when second sound is incident normally on an array of vortex lines in rotating superfluid helium is tested experimentally with a cylindrical resonator rotating on its side. No coupling was detected at any temperature. The measurements indicate that Hall's parameter C' is at least an order of magnitude smaller than the predicted value of 1.8 at 1.34 K. Second sound absorption measurements show that even at the highest rotation speed of 6.2 rad s^{-1} the vortex line density is less than the large cavity limit 2 ω/κ. (auth)

17061 VORTICES AND FAST ELECTRONS IN He II: POSSIBLE EXPERIMENTS AND APPLICATIONS. Stockmann, M. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Phys. Lett., A; 46A: No. 1, 73-74(19 Nov 1973).

The quantized vortex core structure is discussed. The possibility of producing a spark discharge along the vortex cores is considered. Such an effect could be used to visualize vortices and to detect high energy charged particles. (auth)

17062 EXCITATION SPECTRUM OF HELIUM II: A SERIES REPRESENTATION. Brooks, J. S.; Donnelly, R. J. (Niels Bohr Inst., Copenhagen). Phys. Lett., 46A: No. 2, 111-112(3 Dec 1973).

A series representation is described which has pressure dependent phonon dispersion, and which is consistent with neutron scattering and calorimetric data. (auth)

17063 SUPERFLUID FRACTION NEAR T_λ IN DILUTE SOLUTIONS OF ^{3}He IN ^{4}He. Ahlers, G. (Institut fuer Festkoerperforschung, Juelich, Ger.). Phys. Lett., 46A: No. 2, 89-90(3 Dec 1973).

Existing second-sound velocity measurements are interpreted to imply an unexpectedly strong concentration dependence for the amplitude of ρ_s/ρ (auth)

Superconductivity

Refer also to abstracts 16438 and 17508.

17064 (CALT-822-54) SUPERCONDUCTING COMPOSITE OF COPPER AND NIOBIUM: A METALLURGICAL APPROACH. Tsuei, C. C. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Oct 1973. Contract AT(04-3)-822. 18p. Dep. NTIS $3.00.

A study was made of the superconducting properties of Cu–Nb wires prepared by casting and rolling: $Cu_{100-x}\ Nb_x$ and $Cu_{100-1.33x}\ Nb_x\ Al_{0.33x}$, where x = 0.7 to 20, and $Cu_{89.5}\ Nb_{10}\ Al_{0.5}$. Metallography, electron microscopy, and x-ray diffraction were also used. Transition temperatures and critical currents were measured. (DLC)

17065 EFFECT OF LASER RADIATION ON THE TEMPERATURE OF THE SUPERCONDUCTING TRANSITION OF AN Nb–Sn ALLOY. Gridnev, V. N.; Dekhtyar, I. Ya.; Ivanov, L. I.; Karlov, N. V.; Kuz'min, G. P.; Nishchenko, M. M.; Prokhorov, A. M.; Rykalin, N. N.; Yanushkevich, V. A. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 4, 154-155(20 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 4, 258-260(20 Aug 1973).

The temperature dependence of the electric resistance of $Nb_{0.8}-Sn_{0.2}$ samples in the region of T_c before and after application of pulsed-laser radiation was investigated. It is shown that the superconducting-transition temperature rises significantly after the irradiation and that the new state of the alloy is stable. (auth)

17066 GRUENEISEN CONSTANT FOR THE HYDROGEN MODE IN THE PdH SYSTEM. Ganguly, B. N. (Univ. of Illinois, Urbana). Phys. Lett., 46A: No. 1, 23-24(19 Nov 1973).

The recently proposed three square well interaction potential model of superconductivity in conjunction with recent experimental data on the pressure dependence of T_c provides a unique prescription for calculating the Gruneisen constant for the high-frequency hydrogen mode. The alternative procedure for calculating the above Gruneisen constant based on anharmonic effects must await experimental determination of certain physical parameters of PdH. (auth)

17067 ANTICORRELATION OF ATOMIC ORDERING WITH SUPERCONDUCTIVITY IN VANADIUM-BASED TRANSITION-METAL A15 ALLOY. Cox, J. E. (Naval Research Lab., Washington, DC); Waterstrat, R. M. Phys. Lett., 46A: No. 1, 21-22 (19 Nov 1973).

Measurements of the superconducting transition temperature (T_0) of V–Rh A15 alloys reveal that long range order induced by low temperature annealing may cause T_0 to decrease rather than increase. The behavior of T_0 with ordering is discussed for the systems V–Au, V–Pt, V–Ir, V–Os and V–Rh. (auth)

17068 RELATIVE SELF-PHASE IN RESONANT JOSEPHSON JUNCTIONS. Blackburn, J. A.; Nerenberg, M. A. H. (Univ. of Western Ontario, London). Phys. Lett., 46A: No. 1, 15-16(19 Nov 1973).

A phase shift between the perturbed and unperturbed solutions to a self-resonant Josephson junction is suggested and its influence on the zero-frequency current–voltage characteristics is discussed. (auth)

17069 TIME-VARIABLE ELECTROMAGNETICS OF SUPERCONDUCTORS. Fink, H. J. (Univ. of California, Davis). Phys. Lett., 46A: No. 1, 11-12(19 Nov 1973).

A set of four primary, gauge-invariant and coupled differential equations is found which describes temporal and spatial electro-

magnetic phenomena of superconductors within the framework of the Ginzburg–Landau theory. Secondary equations, which are modified London equations, determine the electric and magnetic fields. (auth)

17070 PHASE BOUNDARY RELAXATION EFFECTS IN PURE TYPE I SUPERCONDUCTORS. Chanin, G.; Delon, P. (CNRS, Verrieres-le-Buisson, France). Phys. Lett., 46A: No. 2, 149-150(3 Dec 1973).

The time constant for the growth of the superconducting phase in four type-I superconducting elements has been studied as a function of temperature. The relaxation time versus curves show a complex structure that cannot be correlated with any known transitions. (auth)

17071 NEW CONCEPTION OF THE CRITICAL-VELOCITY MODEL IN SUPERCONDUCTORS. Takacs, S. (Electrotechnical Inst., Bratislava). Phys. Lett., 46A: No. 2, 121-122(3 Dec 1973).

The limitations concerning the applicability and some incorrectnesses in the treatment of the critical-velocity model, based on rigidly pinned vortex lattice, are removed, without changing the field and temperature dependence of the critical current. (auth)

17072 EVALUATION OF THE DENSITY OF ELECTRON STATES IN THE ONE-BAND SUPERCONDUCTING ALLOYS. Moskalenko, V. A.; Ursu, A. M. (Inst. of Applied Physics, Kishinev, USSR). Teor. Mat. Fiz.; 17: No. 1, 142-150(Oct 1973). (In Russian).

On the basis of expressions for the function of density of electron states and functions similar to that one, in a superconductor with small concentration of paramagnetic impurity the electronic entropy at low temperatures, the ratio of the ultrasonic attenuation coefficient in the superconducting phase to the corresponding coefficient for the normal state as well as the coefficient of the electronic thermal conductivity with regard for the scattering of electrons by impurity are calculated. The expressions obtained make it possible the transition to the limiting case of pure superconductor or superconductor with non-magnetic impurity. (auth)

17073 SUPERCONDUCTING ISOTOPE EFFECT OF IRON IN U_6Fe. Engelhardt, J. J. (Univ. of California, La Jolla, San Diego). Solid State Commun.; 13: No. 9, 1355-1356(1 Nov 1973).

The iron isotope effect on the superconducting transition temperature of the compound U_6Fe was found to be very small or zero. ^{54}Fe, ^{56}Fe and ^{57}Fe were used as well as natural iron. (auth)

17074 EFFECT OF MECHANICAL DEFORMATION ON SUPERCONDUCTIVITY OF ALLOYS OF THE Nb_3Al-Nb_3Ge SYSTEM. Alekseevskii, N. E.; Ageev, N. V.; Shamrai, V. F. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 2, 322-326(11 Jul 1973). (In Russian).

Curves are presented for conversion of $Nb_{12}Al_3Ge$ to the superconducting state under different conditions. At a pressure (from all sides) of 6 kbars, the transition curve is reversibly displaced to the lower temperature field. At pressures of 100 kbars and more, the curve is strongly eroded and irreversibly displaced. Mechanical destruction results in a small increase in the lattice parameter but there is no change in the order. The data show that when samples are destroyed by monoaxial pressure, the mosaic is broken up, a value of 400 Å being reached. (TTT)

17075 EFFECT OF CELLULAR PRECIPITATION ON THE SUPERCONDUCTING PROPERTIES OF Al–16,70 at. % Ag ALLOY. Nemoz, A. (CRNS, Grenoble, France). Phil. Mag.; 28: No. 4, 867-880(Oct 1973).

The influence of the growth of the cellular precipitation on the superconducting properties of Al–16,70% At–Ag has been studied. A metallurgical investigation has been made by optical microscopy, transmission electron microscopy and residual resistivity measurements at 4.2K. Critical temperature and critical fields have been deduced from the measurements of the magnetization curve. The results can be explained by adding separately the superconducting properties of the intragranular and cellular regions. By considering volume proximity effects between the normal Ag-rich inhomogeneities and the superconducting Ag-depleted matrix, each region of precipitation is characterized as a type-I or a type-II superconductor. The results also indicate the conditions of validity of the Gorkov-Goodman relation between the upper critical field H_{c_2} of a superconducting material and ρ_0 the residual resistivity. (auth)

17076 VOLTAGE-CURRENT CHARACTERISTICS OF NbTi AND Nb_3Sn SUPERCONDUCTORS IN THE FLUX CREEP REGION. Polak, M.; Hlasnik, I.; Krempasky, L. (Electrotechnical Inst., Bratislava). Cryogenics; 13: No. 12, 702-711(Dec 1973).

The voltage–current characteristics of some high field, high current superconductors are investigated. Small diameter NbTi wires were chosen in order to suppress the heating effects. The parameter characterizing the slope of log E–I curves is evaluated and used to compare the properties of different samples. Some results of current–field angle influence on E–I characteristic are also reported. A mechanism is presented and discussed which could be responsible for premature superconducting–normal state transition of the bare samples. (auth)

17077 DEPRESSION OF THE TRANSITION TEMPERATURE IN SUPERCONDUCTOR-CONTAINING MAGNETIC IMPURITY. II. Bortel, K. (Silesian Univ., Katowice, Poland). Acta Phys. Pol., A44: No. 6, 785-793(Dec 1973).

The depression of the transition temperature of a superconductor containing a magnetic impurity is calculated within the Nagaoka–Suhl approximation. (auth)

17078 COHERENT MOTION OF VORTICES IN SUPERCONDUCTING BRIDGES OF LARGE DIMENSIONS. Gubankov, V. N.; Koshelets, V. P.; Likharev, K. K.; Ovsyannikov, G. A. (Inst. of Radio and Electronics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 5, 171-173(5 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 5, 292-295(5 Sep 1973).

Experimental proof is presented that coherent vortex motion can be realized in superconducting film bridges "of variable thickness" in the absence of the ordering action of magnetic and microwave fields even if the bridge dimensions greatly exceed the coherence length. (auth)

17079 ELECTRON RESONANCE WITH LOCALIZED MAGNETIC MOMENTS OF Er IN SUPERCONDUCTING La. Alekseevskii, N. E.; Garufullin, I. A.; Kochelaev, B. I.; Kharakhash'yan, E. G. (Physical-Technical Inst., Kazan). JETP Lett. (USSR) (Engl. Transl.); 18: No. 5, 189-191(5 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 5, 323-326(5 Sep 1973).

Electron resonance absorption by localized moments of Er in superconducting La was observed. The temperature and concentration dependences of the g-factor and of the line width were investigated. A possible qualitative interpretation of the results is presented. (auth)

17080 ALLOY FOR SUPERCONDUCTIVE MAGNET. Tachikawa, K.; Inoue, K. (to National Research Inst. for Metals). US Patent 3,761,254. 25 Sep 1973. Priority Date 3 Feb 1970, Japan. 6p.

A ternary alloy for superconducting magnets is described, which is composed of V, Hf, and M where M is zirconium, chromium, or tantalum. (auth)

17081 NEUTRON DIFFRACTION, MAGNETIC, AND SUPERCONDUCTING. Measurements on Vanadium–Manganese–Gallium Alloys. Kitchingman, W. J.; Norman, P. L. (Univ. of Manchester, Eng.). J. Appl. Crystallogr.; 6: No. 3, 240-243(1 Jun 1973).

Eleven alloys from the binary and ternary range $(VMn)_2Ga_5$ have been investigated using neutron powder diffraction methods supported by measurements of magnetic susceptibility and superconducting transition temperatures. A magnetic structure is present in alloys in the composition range around $(Mn_{0-3}V_{0-3})_2Ga_5$ to Mn_2Ga_5. The magnetic moment found in the alloy Mn_2Ga_5 increases on the addition of vanadium to a maximum around the composition $(Mn_{0-3}V_{0-3})_2Ga_5$. It then decreases and disappears around the composition $(Mn_{0-2}V_{0-3})_2Ga_5$. Possible changes in the magnetic structure are suggested in order to account for this. There is some evidence of weak superconductivity in the alloy V_2Ga_5. This disappears on the addition of manganese. (auth)

17082 SEARCH FOR NEW AND BETTER SUPERCONDUCTORS. Smith, T. F. (Univ. of California, San Diego, La Jolla). Aust. Phys.; No. 10, 163-165(Oct 1973).

17083 NEUTRON-SCATTERING EXPERIMENT ON COEXISTENCE OF SUPERCONDUCTIVITY AND FERROMAGNETISM. Roth, S.; Ibel, K.; Just, W. (Institut Max-von Laue–Paul Langevin, Grenoble, France). J. Phys., C (London); 6: No. 23, 3465-3468(27 Nov 1973).

The magnetic ordering of $Ce_{0-3}Tb_{0-2}Ru_2$ was investigated by neutron scattering above and below the superconducting transition point at 2.6°K. Ferromagnetic short-range ordering was found with a correlation length of 15.6 Å at 1.5°K. No significant difference between the ordering in the normal and in the superconducting phase was observed. (auth)

17084 STATISTICAL THEORY OF PINNING ON POINT DEFECTS. Takacs, S. (Electrotechnical Inst., Bratislava). Czech. J. Phys.; 23: No. 10, 1068-1076(1973).

The statistical treatment of pinning on point defects is given including the correlations of the number of defects in neighboring volumes (the interaction of these volumes with the fluxoid is taken

as the elementary interaction causing the pinning). For higher defect densities, the agreement with the experiments on niobium is better than with the previous theory. This method of correlations seemed suitable for studying the effect of "cutting-off" the small elementary interactions and for the replacement of the Gauss distribution function by the Poisson distribution function for the number of defects in the elementary volumes. Both these efforts give negative results with respect to the experiments; so far we are therefore not able to explain quantitatively the large increase of the pinning force at small defect densities and small magnetic fields, as well as its decrease to zero always for fields smaller than H_{c2}. The attractive interaction between the flux lines in type-II superconductors with small Ginzburg-Landau parameter could give a qualitative explanation of the enhancement of the pinning at small defect densities. (auth)

17085 PARAMAGNETIC EFFECTS IN SUPERCONDUCTORS. Aronov, A. G. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 228-229(20 Sep 1973).

Translated from Zh. Eksp. Fiz., Pis'ma Red.; 18: No. 6, 387-390(20 Sep 1973).

The magnetic properties of non-equilibrium superconductors are investigated. It is shown that under certain conditions the superconductor can go over from the state of an ideal diamagnet into a state with "ideal" paramagnetism. In that case the magnetic field penetrates into the superconductor and oscillates as a function of the coordinate. (auth)

Equipment and Devices

17086 (RL-73-114) WEIBULL'S FAILURE THEORY APPLIED TO AN EPOXY RESIN. Colyer, B. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

Weibull's theory of failure is applied to fracture stress values of an epoxy resin, measured at room and liquid helium temperatures, for use in superconducting magnets. A value of about 3 is obtained for the parameter b in the cumulative distribution function $F(x) = 1 - \exp[-V(x^b/\Theta)]$ where F(x) is the probability of rupture of a material sample at a given stress x, V is the volume of the sample, b is called the shape parameter and Θ the scale parameter, or Weibull's mean stress, is that stress which for unit volume of material gives the probability of rupture $F(x) = 0.63$. The method is probably better than arithmetic averaging when calculating the mean fracture stress from a small number of tests. (auth)

17087 EFFECT OF THE EXTERNAL CIRCUIT IMPEDANCE ON THE I-V CHARACTERISTIC OF A JOSEPHSON JUNCTION. Volkov, A. F. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 12, 2068-2070(Dec 1972).

Translated from Radiotekh. Elektron.; 17: No. 12, 2581-2583 (Dec 1972).

A point contact of S/N/S system type of Josephson junction, connected in parallel with a circuit with impedance $Z(\omega)$, is discussed. It is suggested that the impedance at the characteristic Josephson oscillation frequency exceeds the junction resistance in its normal state. The I-V characteristic of the system is calculated. It is found that the frequency dependence of the real part of $Z(\omega)$ can be determined from the shape of the I-V characteristic. (auth)

17088 SEPARATION DEPENDENCE OF THE COUPLING IN SUPERCONDUCTING DC TRANSFORMERS. Lindstrom, W. A.; Sherrill, M. D. (Clemson Univ., SC). Phys. Lett., 46A: No. 2, 77-78(3 Dec 1973).

For superconducting dc transformers with 400 nm tin primaries separated from 300 nm tin secondaries by SiO insulation the coupling parameter V_s/V_p decreases from unity to zero as the SiO thickness increases from 500 nm to 1500 nm. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 17472, 17703, 17713, and 17715.

17089 (AEEW-M-1208) CURRENT EDITION OF THE MAIN TAPE NDL-1 OF THE UK NUCLEAR DATA LIBRARY, MARCH 1973. Pope, A. L. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Dec 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

This document summarizes the content of the lately revised main tape NDL-1 of the UKNDL. It quotes the energy range of cross-section tabulations together with a list of tabulated reactions. It refers to the data sources and comments on their origin and newness. It should be read in conjunction with AEEW-M 1191, which complements this document. (2 tables) (auth)

17090 (CONF-731207-1) ETOE-2/MC^2-2/SDX MULTIGROUP NEUTRON CROSS-SECTION PROCESSING. Henryson, H. II; Toppel, B. J.; Stenberg, C. G. (Argonne National Lab., Ill. (USA)). 1973. 20p. Dep. NTIS $3.00.

From seminar on codes for nuclear data processing; Ispra-Varese, Italy (5 Dec 1973).

The ETOE-2/MC^2-2/SDX code system provides a comprehensive neutron cross-section processing capability. The three components of the system include an ENDF/B library processor (ETOE-2), an ultra-fine-group fundamental mode calculation (MC^2-2), and an intermediate-group space-dependent capability (SDX). Brief descriptions of the types of calculations are discussed. Selected results from typical problem executions are presented. (auth)

17091 (JUL-971-MA) PROPERTIES OF CERTAIN INTEGRO-DIFFERENTIAL EQUATIONS OF THE BOLTZMANN TYPE IN LEBESGUE SPACES. Ebersoldt, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Angewandte Mathematik). Jul 1973. 117p. (In German). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis. Submitted to Univ., Duesseldorf.

The integro-differential equations of the BOLTZMANN type which play an important role in neutron transport theory are studied. Eigenvalue problems as well as existence and uniqueness of non-negative solutions for given boundary conditions are investigated. Furthermore, necessary convergence conditions of the MAREK iteration method, used to find a certain eigensolution, are named. (RW) (GE)

17092 (N-73-30715) EXPERIMENTAL INVESTIGATION OF RESONANCE SELF-SHIELDING AND THE DOPPLER EFFECT IN URANIUM AND TANTALUM. Final Report. Byoun, T. Y.; Block, R. C.; Semler, T. T. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jun 1972. 36p. (NASA-TM-X-69565). NTIS $4.00.

A series of average transmission and average self-indication ratio measurements was performed in order to investigate the temperature dependence of the resonance self-shielding effect in the unresolved resonance region of depleted uranium and tantalum. The measurements were carried out at 77°K, 295°K, and approximately 1000°K with sample thicknesses varying from approximately 0.1 to 1.0 mean free path. The average resonance parameters as well as the temperature dependence were determined by using an analytical model which directly integrates over the resonance parameter distribution functions. (auth)

17093 (STI/PUB-343(Vol.2)) NUCLEAR DATA IN SCIENCE AND TECHNOLOGY. Volume II. Proceedings Series. Proceedings of the Symposium Held in Paris, France, March 12-16, 1973. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. 603p. (In several languages). (CONF-730302-(Vol.2)). IAEA $26.00.

Information on the use of nuclear data in science and technology is presented in sections with the following titles: fusion research; evaluated neutron data files; activation analysis: general; activation analysis: neutrons; compilation and evaluation—data centers; large-volume compilations; various applications; activation analysis: charged particles and photons; application-oriented compilations and evaluations; and symposium summary and round table discussion. Separate abstracts were prepared for 36 of the papers appearing in this report; the remaining four have already appeared in NSA with the following abstract numbers: 27: 18716, 27: 21411, 27: 26050, and 28: 00486. (RWR)

For abstracts of individual papers see: 15257-15268, 15708, 15743, 15775, 17104-17115, 17267, 17268, 17284, 17436, 17437, 17473, 17649, 17713, and 17714.

17094 (UCID-15849) TART MONTE CARLO CALCULATIONS OF 14.0 MeV NEUTRON TRANSPORT IN HOMOGENEOUS AIR. Plechaty, E. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1971. 18p. Dep. NTIS $3.00.

The Monte Carlo neutron transport code, TART, recently developed at the Lawrence Radiation Laboratory, was used to calculate the transport of 14.0-MeV neutrons from a point source in a homogeneous atmosphere of air ($N_{.8}O_{.2}$ at a density of 1.29×10^{-3} g/cm^3). The results are compared with several previous calculations. (11 figures) (auth)

17095 (UCID-16426) PROGRAM SIGMA 1 (VERSION 74-1). Cullen, D. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1974. Contract W-7405-eng-48. 12p. Dep. NTIS $3.00.

The program SIGMA 1 is designed to Doppler-broaden and/or thin tabulate pointwise cross sections in the ENDF/B BCD format. The broadening is performed from an initial (not necessarily 0°K) temperature to up to 100 final temperatures. Each section of File 3 is assumed to be a linear-linear table of pointwise cross section vs energy. The program is written entirely in FORTRAN IV, and has been implemented on the CDC 6600/7600 and IBM 360. The program requires the following units: input, output, the original data, the broadened data, and two scratch files. Core requirement on the CDC 7600 is 20 K, and the time required to Doppler-broaden ^{238}U from 0°K to 293°K is 45 seconds of CDC 7600 time. Input and output for a sample problem are shown. (1 figure) (RWR)

17096 EXACT SOLUTION OF A TRANSCENDENTAL EQUATION BASIC TO THE THEORY OF INTERMEDIATE RESONANCE ABSORPTION OF NEUTRONS. Siewert, C. E. (Univ., Karlsruhe, Ger.); Kriese, J. T. J. Nucl. Energy; 27: No. 12, 831-837(Dec 1973).

The theory of complex variables is used to solve explicitly a transcendental equation essential to the intermediate-resonance-absorption theory for neutrons. The closed-form solutions are expressed ultimately in terms of elementary quadratures. (auth)

17097 TWO-STAGE EXCITATION OF NUCLEI TO OBTAIN STIMULATED GAMMA-QUANTUM EMISSION. Gol'danskii, V. I.; Kagan, Yu.; Namiot, V. A. (Inst. of Chemical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 34-35(5 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 61-63(5 Jul 1973).

The possibility of increasing the density of excited nuclei if pulsed radiative capture of neutrons with population of the Moessbauer level takes place in one target, and the emitted gamma quanta are then resonantly absorbed in a second target is discussed. (auth)

17098 MEASUREMENT OF STEADY-STATE, SPACE-DEPENDENT, THERMAL-NEUTRON SPECTRA IN BERYLLIUM ASSEMBLIES WITH STRONG TRANSVERSE LEAKAGE. Lake, J. A.; Kallfelz, J. M. (Georgia Inst. of Tech., Atlanta). Nucl. Sci. Eng.; 53: No. 1, 27-46(Jan 1974).

Thermal-neutron energy spectra have been measured as a function of transverse buckling and of space position along the longitudinal axes of 25.4- × 25.4- and 35.6- × 35.6-cm beryllium assemblies by the slow-chopper, time-of-flight technique using the thermal column of the Georgia Tech Research Reactor as the steady-state neutron source. For neutrons moving in the (forward) positive Z direction, no evidence was found of the establishment of, or the tendency toward, discrete asymptotic decay conditions from the strongly space-dependent spectra in either assembly. This is a direct experimental verification of the disappearance of the discrete set of eigenvalues and eigenfunctions in the diffusion-length problem with transverse leakage. These results are in at least qualitative agreement with the transport theory predictions of Williams, but in disagreement with the diffusion theory results of Ahmed, Kothari, and Kumar which predict that a true discrete mode should exist in beryllium assemblies as small as 30 × 30 cm. (auth)

17099 NUMERICAL SOLUTION OF THE LINEAR INTEGRAL BOLTZMANN EQUATION. Cullen, D. E. (Lawrence Livermore Lab., CA). Nucl. Sci. Eng.; 53: No. 1, 93-106(Jan 1974).

An iterative method is proposed for solving the homogeneous (i.e., critical) or inhomogeneous (i.e., source) linear integral Boltzmann equation for general geometry. By using successive approximations, these two classes of problems are shown to be mathematically equivalent. For the homogeneous problem, constraints on the algorithm regarding the existence of eigenvalues and the initial approximation are investigated. The algorithm is

applied to isotropically scattering slabs and spheres, and is compared with previously published results as well as an independent extrapolation method. For the inhomogeneous problem, an improvement over the normal successive collision method via the use of a Neumann series expansion is used to allow economic parametric studies. Constraints on the algorithm and methods of efficiently terminating the infinite Neumann series are investigated. The solution via the proposed method as applied to isotropically scattering slabs and spheres is provided in a compact form for a range of multiplication factors and optical dimensions. The shape of the scalar flux distribution is explained. Extensions of the method to more complex problems are outlined; in particular, the solution to an energy-dependent problem in general geometry is obtained, and the implications of the results are discussed. (7 figures, 2 tables) (auth)

17100 VARIANCE REDUCTION IN MONTE CARLO CALCULATIONS OF MULTIPLE SCATTERING IN NEUTRON SCATTERING EXPERIMENTS. Kalli, H. (Helsinki Univ. of Tech., Otaniemi, Finland). Acta Polytech. Scand., Phys. Nucl. Ser.; No. 95, 1-26(1973).

Techniques for increasing the computational efficiency in the Monte Carlo estimation of multiple scattering in neutron scattering experiments are discussed. The results are obtained by studying means of reducing the variance for the twice scattered neutrons. In thin slab samples the variance is shown to be strongly dependent on the probability density function used in sampling the neutron direction after the first scattering. Studies of simple one-velocity cases indicate the proper choice of this probability density function. Multiple scattering in a free gas sample is studied as an application. (auth)

17101 CRITERIA OF CHOICE FOR COMPILATIONS OF NUCLEAR DATA. Horen, D. J. Weinberg, A. M. (Oak Ridge National Lab., TN). pp 3-11 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol.1); CONF-730302-(Vol.1).

The distinction between internal and external criteria for scientific choice is explained, and the necessity of making choices in the compilation of nuclear information is indicated. The criteria are then discussed in more detail-internal criteria: nuclear compilation as part of nuclear science and external criteria: nuclear compilation as an aid to application. A strong and growing need for externally motivated nuclear compilations is seen for the future. It is felt that the compiler must seek out potential users, and several mechanisms which might facilitate this task are suggested. (1 figure, 1 table) (RWR)

17102 USE OF NEUTRON RESONANCE PARAMETERS AND NEUTRON RADIATIVE CAPTURE CROSS-SECTIONS IN EVALUATING RESOLVED AND UNRESOLVED ACTIVATION RESONANCE INTEGRALS. Ricabarra, G. H.; Turjanski, R.; Ricabarra, M. D. (Comision Nacional de Energia Atomica, Buenos Aires). pp 163-174 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In Spanish)

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.1); CONF-730302-(Vol.1).

The paper reviews work carried out on the calculation, evaluation, and measurement of activation resonance integrals. The calculation methods used are described, and an analysis is made of the error introduced in the evaluation of the resolved resonance integral as a result of the current uncertainty in neutron resonance parameters. The calculation of the unresolved resonance integral is described, and the neutron radiative capture cross-section data in the region between 1 keV and 10 MeV available for its calculation are considered. The use of experimental resonance integral values in evaluating neutron parameters in cases where the neutron parameters obtained by differential time-of-flight measurements show discrepancies is also described. Finally, an account is given of the difficulties that arise in reactor physics and/or activation analysis when inexact or inadequate integral data are used. (2 figures, 4 tables) (auth)

17103 FILE OF DATA RELATED TO FISSION PRODUCTS. Devillers, C. (CEN, Fontenay-aux-Roses, France); Blachot, J.; Lott, M.; Nimal, B.; N'guyen Van Dat; Noel, J. P.; deTourreil, R. pp 477-503 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.1); CONF-730302-(Vol.1).

The data necessary for calculating the concentrations and the β and γ activities of fission products are described. The file, which is based on the ENDF/B format, results from compilation and evaluation of the available data. It contains the fission yields for the most common fissions, isobar chain schemes, the transition probability tables, and the gamma spectra. The main work of compilation and evaluation relates to the decay schemes, for which the data, grouped for 622 isotopes (^{71}Zn to ^{170}Yb), are as follows: period, Q_β (β transition energy) and the internal transition energy in the case of isomerism, β transition probabilities and their energy, relative or absolute gamma-ray intensities and their energy, and references. Residual power measurements which provide overall confirmation of the assembled body of data are presented. (3 figures, 4 tables) (auth)

17104 PRELIMINARY COMPARATIVE ANALYSIS OF AMERICAN AND GERMAN NUCLEAR DATA FILES FOR FAST-FISSION-REACTOR CALCULATIONS. Yiftah, S.; Gur, Y.; Segev, M.; Gitter, L. (Soreq Nuclear Research Center, Yavne, Israel). pp 75-82 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

The American ENDF/B III, the German KEDAK, the British UKNDL, and the Russian evaluated nuclear data files today serve as the main sources of the nuclear data for the calculation of fission reactors. Specifically, the files serve as the major sources of nuclear input for the calculations in the framework of the various big and expensive fast-reactor programs. Each country, naturally, uses its evaluated file, and the question that has been asked for some time is the following: are the physics parameters of the fast reactors being calculated and designed a function of the specific evaluated data file that is used in the calculations? In other words, would these physics parameters remain the same were the calculations to use a different evaluated data file as input? To shed some light on this problem, a study was undertaken where the comparative analysis of the evaluated files is performed on several levels, i.e. the basic-microscopic-data level, the multigroup-cross-section-set level, and the physics-parameters-of-specific-systems level. In this paper, typical 1000 to 1200 MW(e) fast reactor systems of about 6000 to 7000 litre core modelling-the target fast reactors being designed today by the major countries having an active fast reactor program-are calculated using the evaluated nuclear data files ENDF/B III and KEDAK as nuclear input. Identical techniques are used to obtain multigroup sets from the files. Also, the reactor physics codes used are the same. The differences in results can, therefore, be attributed directly to the differences in the nuclear data input. Practical conclusions and recommendations are presented. (6 tables) (auth)

17105 SYSTEMATIC TEST OF THE ENDF-B/3 EVALUATED CROSS-SECTION LIBRARY ON CLEAN CRITICAL ASSEMBLIES. Wagschal, J. J.; Yaari, A. (Hebrew Univ., Jerusalem). pp 83-101 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol.2); CONF-730302-(Vol.2).

The use of integral data to test or even to modify neutron cross-sections has been popular for almost a decade. Recent tests performed on the new ENDF-B/3 evaluated neutron cross-sections compilation are described. Fifteen "clean" measurements of critical masses of bare and reflected, plutonium and uranium spheres served as integral data. The specifications of most of these critical assemblies have been reevaluated and published in 1969. The quoted experimental errors in the critical masses of these assemblies were translated individually for each system into an uncertainty in the effective multiplication factor k_{eff}. The effective multiplication factors k_{eff} of the critical assemblies were calculated in a forty-group transport S_8 approximation, and the proper adjustments needed to account for anisotropic scattering and for the finite-differences scheme were carefully calculated for each assembly. All calculated k_{eff} fell outside the quoted uncertainties. A least-squares and perturbation scheme for the use of integral data in cross-section adjustments was applied to these critical masses and to the ENDF-B/3 ^{235}U, ^{238}U and ^{239}Pu cross sections. The new effective multiplication factors k_{eff} are now well within the quoted experimental errors, and the adjustments needed in the cross-section evaluation are minor. The numerical results are presented and discussed. (auth)

17106 ROLE OF INTEGRAL EXPERIMENTS IN THE PRODUCTION OF NUCLEAR DATA FOR REACTOR CORE AND SHIELD DESIGN AND FOR IRRADIATION EXPERIMENTS. Farinelli, U. (CNEN, Rome). pp 103-119 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

The inadequacy of differential measurements is briefly reviewed. A general scheme of a "global approach" taking into account both differential and integral information is derived. The various philosophies that can be employed in designing integral experiments and in using their information are critically reviewed. The application of this type of approach to fast-reactor cross-sections and the bases for the feedback to nuclear data evaluations and for adjustment procedures are reviewed. The possibility of using these methods to uncover systematic errors is examined. The extension of these procedures to other areas is discussed; in particular, the interactions of calculational model and nuclear data in thermal reactor design are considered. In the case of shielding, the same problem is paralleled by the necessity of extending the sensitivity calculations. In the irradiation experiments and, in particular, for the cross-sections of the integral detectors used, the connection of nuclear data, integral experiments and damage functions is discussed, and the usual criterion of spectrum unfolding is shown to be too restrictive for practical purposes. (auth)

17107 EXPANDING ROLE OF THE UNITED STATES NUCLEAR DATA COMMITTEE. Havens, W. W. Jr. (Columbia Univ., New York); Kolstad, G. A.; Chrien, R. pp 303-317 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

The need for exchange of information between measurers, compilers, evaluators, and users of nuclear data has long been recognized in the reactor physics field. Both National and International Advisory Committees have encouraged active cooperation. In the United States, the US Nuclear Data Committee fills the role. On the international level, the European-American Nuclear Data Committee and the International Nuclear Data Committee occupy similar advisory roles under the auspices of the Nuclear Energy Agency of OECD and the International Atomic Energy Agency, a UN body. It has recently become clear that it is necessary to promote close ties between measurers, compilers, and users in the non-neutron data fields. In the United States, the USNDC now assists in establishing a feedback from users to measurers by compiling a request list for measurements needed for fission reactors, safeguards, fusion reactors, and biomedical and basic physics applications. The mechanism for doing this was to create a number of specialized subcommittees to survey the needs and establish user-measurer relationships in these specialized fields. These subcommittees will emulate the relationships which have been so successful in the reactor physics field. To the extent possible, the committee and subcommittee members implement their own recommendations. The committee also makes available to users status reports on measurements currently planned or underway, and sponsors conferences and symposiums. The USNDC operates under the general auspices of the US Atomic Energy Commission with participation from other government agencies, including the National Bureau of Standards, the Department of Defense, and the National Science Foundation. (3 tables) (auth)

17108 CENTER FOR COLLECTION, EVALUATION, AND DISSEMINATION OF NON-NEUTRON NUCLEAR DATA. Chukreev, F. E. (Inst. of Atomic Energy, Moscow). pp 319-323 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

In accordance with a recommendation made by the International Atomic Energy Agency, the USSR State Committee on the Utilization of Atomic Energy decided in 1972 to establish a center for the collection, evaluation, and dissemination of non-neutron nuclear data. The scope of the center's operations and the plans for carrying out its tasks are described. (auth)

17109 NUCLEAR DATA PROJECT: OPERATIONS, STATUS, AND PLANS. Horen, D. J. (Oak Ridge National Lab., TN). pp 325-333 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

A description of the operations of the Nuclear Data Project is presented. This includes a discussion of the Project's reference systems, compilation and evaluation efforts, generation of a nuclear structure data file, and the types of publications and services offered. The status of the mass-chain compilations for A > 44 is reviewed. Interactions between the Project and other compilation groups will be noted. Some time will be devoted to future plans for handling the abundance of nuclear data being generated, and the contemplated modifications to the Project's methods of communicating with producers and users of nuclear data. (3 figures) (auth)

17110 PRINCIPLES OF OPERATION OF THE CENTER FOR DATA ON NUCLEAR STRUCTURE AT THE LENINGRAD INSTUTUTE OF NUCLEAR PHYSICS. Kondurov, I. A. (Leningrad Inst. of Physics). pp 335-340 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

The Data Center at the Leningrad Institute of Nuclear Physics is intended to free research workers from routine tasks when handling data, whether the latter are the results of their own research or the findings of others. The basic principles of operation of the Center may be summarized as follows: the establishment and constant expansion of an automated reference system on the structure of the nucleus and on elementary particles, with operational access to the data and to the system of programs for working therewith. It is intended to accumulate data and calculations within a framework of broad cooperation and exchanges with related regional centers. (1 figure) (auth)

17111 NEUTRON-CAPTURE GAMMA-RAY COMPILATIONS. Bartholomew, G. A. (Chalk River Nuclear Labs., Ont.). pp 343-352 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

Neutron-capture gamma-ray compilations are discussed with particular attention to the Chalk River-Kurchatov compendium. Possible future developments are considered in relation to applied needs. (1 figure, 4 tables) (auth)

17112 SURVEY OF NUCLEAR DATA USE IN APPLIED FIELDS. Lederer, M.; Hollander, J. M. (Univ. of California, Berkeley). pp 449-456 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol.2); CONF-730302-(Vol.2).

In connection with compilation activities for the Table of Isotopes, a survey of nuclear data needs outside the field of basic nuclear science was conducted, principally among users of radioisotopes. Questionnaires were mailed to people in such diverse fields as medicine, environmental studies, and oceanography. The questions were intended to ascertain what sources of data are used, what specific types of data are required, to what extent existing compilations fill these needs, and what changes are needed or desired. Several questions at the end of the list concerned specifically the use of the Table of Isotopes. A preliminary summary of the response to date to the survey is discussed. (4 figures) (auth)

17113 EVALUATION OF DECAY SCHEME PARAMETERS. Bambynek, W. (EURATOM, Geel, Belgium); Grinberg, B.; Hansen, H. H.; Lagoutine, F.; Le Gallic, Y.; Legrand, J.; De Roost, E.; Spernol, A.; Wapstra, A. H.; Weiss, H. M. pp 521-527 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

The use of radionuclides is partly a function of the knowledge of the parameters by which they are characterized. While in many cases an accuracy of 1 to 2% is sufficient, an accuracy of 0.1 to 0.2% is needed for certain applications. The latter accuracy can be achieved for many parameters, but only very few decay schemes are known with such an accuracy. This is the reason why the BCMN/IKO/PTB/LMRI group has decided to evaluate these schemes to a higher accuracy. The method of work and the evaluation rules adopted are reported; some examples of evaluation are given. (auth)

17114 DEVELOPMENT OF COMPUTER-BASED NUCLEAR DATA COMPILATION: TABLE OF ISOTOPES. Lederer, M.; Hollander, J. M. (Univ. of California, Berkeley). pp 541-550 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

On the basis of a proposal made by the authors in 1968, they are proceeding to apply computer techniques to the production of the next (7th) and future editions of the Table of Isotopes.

The use of computers is intended to accomplish several goals: to reduce the probability of errors and simplify the compiler's job by improvements in the data-input procedure by computer checks for all possible machine-detectable errors in the syntax and in the physics of the input data and by elimination of redundant entry and proofreading of data re-used in succeeding editions of the Table of Isotopes; to shorten the time delay between the cut-off data for acceptance of new literature and the publication of the compilation by nearly complete automation of the production process; to enable the authors to produce automatically sorted or inverted compilations, such as tables of gamma rays from all isotopes produced by neutron capture in natural targets, ordered by energy; and to eliminate redundant entry of abstracted data by different compilers whenever possible. An important part of the computer automation is the development of a text input and editing system for direct keyboarding of complex text. This system is being used for input of all tabular data. Graphical data (level schemes) are input in tabular form on punched cards and plotted by computer. A major saving in effort and improvement in accuracy should thus be obtained because level schemes can be modified easily and redrawn automatically, without the need for extensive drafting and redundant proofreading. (5 figures) (auth)

17115 NUCLEAR DATA TABLES: A MAJOR DATA OUTLET. Way, K. (Duke Univ., Durham, NC). pp 551-554 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

The importance of Nuclear Data Tables as a major outlet of nuclear data is, nearly seven years after initial publication, emphasized; and achievements to date and hopes for the future are discussed. Historical notes are given to provide background and perspective. (2 tables) (auth)

17116 MEASUREMENT AND CALCULATION OF SPACE-DEPENDENCE OF THERMAL NEUTRON SPECTRA AT AN INTERFACE. Voigts, W. (Kernforschungszentrum, Karlsruhe, Ger.). Atomkernenergie; 22: No. 1, 9-13(Sep 1973). (In German).

In the vicinity of a plane interface between D_2O and poisoned D_2O space-dependent neutron spectra were measured by the time-of-flight method and compared with calculations. It was demonstrated that the spectra can be described well by a neutron temperature which is a universal function of a generalized loss rate. The experiments agreed well with the calculations. This was true for the space-dependence only in case the THERMOS code was used in a newly developed P_1 approximation. The considerable distortions caused by the reentrant hole were shown to be predicted well by an approximate calculation. (5 figures) (auth)

17117 SECOND-ORDER DISCRETE ORDINATE P_L EQUATIONS IN MULTI-DIMENSIONAL GEOMETRY. Jung, J.; Ohtani, N.; Kobayashi, K.; Nishihara, H. (Kyoto Univ.). J. Nucl. Energy; 27: No. 8, 577-590(Aug 1973).

Discrete ordinate neutron transport equations which are equivalent to the P_L approximation are derived in order to eliminate the current problem in the numerical solutions for the transport equation. The number of the unknowns which remain to be solved in the discrete ordinate equations is consistent with that of the independent basic functions appearing in the P_L solution. For even P_L approximation in one-dimensional slab geometry, a system of equations which are satisfied by the L unknowns is derived by eliminating the L-th Legendre moment. For multi-dimensional geometry, discrete ordinate equations of the second order which are equivalent to the P_L approximation are proposed by following Davis' method for the derivation of the even-parity second-order form of the odd P_L equations. In this case, the total number of the quadrature points is just equal to that of the independent basic functions. Finally, the boundary conditions of the P_L approximation in x-y geometry are transformed into those for the corresponding discrete ordinate equations. As for the boundary conditions, material interface, reflecting and vacuum boundary conditions are considered. (auth)

17118 MEASUREMENTS OF THE DIFFUSION PARAMETERS IN DIPHENYL AT TEMPERATURES FROM 20°C TO 170°C. Cervena, J.; Bayer, R.; Schaferlingova, W. (Inst. of Nuclear Physics, Rez, Czech.). Czech. J. Phys.; 23: No. 11, 1187-1195 (1973).

The diffusion coefficient, mean lifetime of thermal nuetrons, coefficient of diffusion cooling, and diffusion length in diphenyl at temperatures of 20°, 40°, 60°, 80°, 110°, 140°, and 170°C were measured by the pulse method. Their dependence on the temperature of diphenyl was deduced in an analytic form, and the change of the neutron transport length was determined experimentally. No discontinuity of the diffusion coefficient at the melting point of diphenyl was observed, apart from that caused by density change. The energy exchange cross section M_1 is practically independent of temperature in the range from 20°C to 170°C, and the deduced microscopic absorption cross section for hydrogen equals 337 ± 2 millibarns. The thermalization of neutrons in diphenyl proceeds more slowly than in water, and neutrons lose their energy predominantly by interaction with the C-H group of the diphenyl molecule. (auth)

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Refer also to abstracts 16880, 16885, 16961, 17029, and 17033.

17119 (LA-5443-C, pp 177-185) EFFECTS OF SPIN AND ISOSPIN DEGREES OF FREEDOM FOR PION-NUCLEUS SCATTERING IN THE GLAUBER-THEORY. Hess, A. T.; Eisenberg, J. M. (Univ. of Virginia, Charlottesville). Oct 1973.

From LAMPF summer school on the theory of pion-nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

The elastic scattering of negatively charged pions from ^{12}C and ^4He in the region of the 3,3 resonance was considered using the Glauber multiple-scattering theory. Both spin-flip excitations and charge-exchange transitions are included. It is assumed that after every two scatterings the nucleus returns to the ground state. The sum over intermediate excited states internal to the successive pairs of scatterings is evaluated using closure techniques. Antisymmetrized shell-model wave functions are used for the nuclear states, and Fermi motion effects are included in first order. The scattering series is evaluated numerically. The results indicate that at energies below the 3.3 resonance the spin and isospin degrees of freedom are important but their inclusion does not bring about agreement with experiment. Above the resonance they do help to improve agreement with the data. (auth)

17120 RELATIONSHIP OF QUADRUPOLE-QUADRUPOLE INTERACTIONS TO SU(3) INVARIANCE AND ROTATIONAL BANDS FOR A FOUR-NUCLEON SYSTEM. Turner, R. J.; Trainor, L. E. H. (Univ. of Toronto). Can. J. Phys.; 51: No. 2, 170-179 (15 Jan 1973).

The nature of the quadrupole-quadrupole interaction in a simple harmonic oscillation model is analyzed in some detail, with particular reference to group symmetries, SU(3) invariance, and the existence of rotational or quasi-rotational bands. Basis states having good space symmetry and SU(3) and R(3) quantum numbers are constructed using the methods of Moshinsky and collaborators. The multi-shell calculations are limited for reasons of tractability to the 4-nucleon system. The results show that the SU(3) model is highly idealized and that the appearance of SU(3) symmetry and rotational bands is strongly influenced by major shell mixing, changes in the radial dependence of the force, and even to some extent by inclusion of self-energy terms in the quadrupole-quadrupole interaction. (auth)

17121 ^2H-d REACTIONS BELOW 200 keV. Fick, D.; Weiss, U. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Phys.; 265: No. 1, 87-104(Oct 1973).

The $^2H(d,n)$- and $^2H(d,p)$-reactions are studied for deuteron energies below 200 keV. It is shown that the R-matrix approach of Konopinski and Teller, which is very sensitive to the channel radius used, can be approximated in a way that the dependence on the channel radius does not appear explicitly. This approach appears to be formally equivalent to a kind of "direct approach" of Boersma. This equivalence answers the question why a direct approach to these reactions works at all at low energies. Each reaction is described by three parameters which are determined in a fit to the up to now available data. (GE)

17122 EFFECTS OF SPIN AND ISOSPIN DEGREES OF FREEDOM FOR PION-NUCLEUS SCATTERING IN THE GLAUBER THEORY. Hess, A. T.; Eisenberg, J. M. (Univ. of Virginia, Charlottesville). Phys. Lett., 47B: No. 4, 311-314(26 Nov 1973).

Elastic pion scattering was examined in the 3,3 resonance region using Glauber theory and including nucleon spin and isospin degrees of freedom, as well as all s- and p-wave channels for the πN system. (auth)

17123 NATURAL WIDTH OF THE GROUND STATE OF ^5He. Garnir, H. P.; Robaye, G.; Delbrouck-Habaru, J. M. (Univ., Liege). Bull. Soc. Roy. Sci. Liege; 42: No. 5-6, 195-205(1973). (In French).

The width of the ^5He ground state was measured using the $^7Li(d,\alpha)^5He$ reaction, the value found in the center of mass system is equal to $\Gamma_{c.m.} = (615 \pm 30)$ keV. The measurements were

performed using semiconductor detectors with and without $\alpha-\alpha$ coincidence method. (auth)

17124 ALPHA–DEUTERON CLUSTER STRUCTURE OF ^{6}Li. Lim, T. K. (Drexel Univ., Philadelphia). Phys. Lett.; 47B: No. 5, 397-398(10 Dec 1973).

It is shown that the dependence on energy and incident projectile of the α-d cluster probability in ^{6}Li, as obtained from quasi-free scattering (QFS) reactions, can be explained through the plane-wave-impulse approximation (PWIA) by introducing a transmission factor and using Eckart cluster wave functions. The invariant cluster probability extracted from a number of (p,pα) and (α,2α) reactions at low energy are then found to be in agreement with those from high energy QFS and transfer reaction analyses. (auth)

17125 HARTREE–FOCK CALCULATIONS FOR HIGHLY DEFORMED SYSTEMS. Passler, K. H.; Zint, P. G.; Mosel, U. (Univ., Giessen, Ger.). Phys. Lett.; 47B: No. 5, 419-421(10 Dec 1973).

Hartree–Fock calculations using the Skyrme force have been performed for highly deformed or separated systems in the basis of eigenfunctions of the two-center harmonic oscillator. (auth)

17126 EVIDENCE OF A 2$^+$ STATE FROM THE ^{4}He(γ,n)^{3}He REACTION. Malcom, C. K.; Webb, D. V.; Shin, Y. M.; Skopik, D. M. (Univ. of Saskatchewan, Saskatoon). Phys. Lett.; 47B: No. 5, 433-435(10 Dec 1973).

The ^{4}He(γ,n)^{3}He differential cross section was simultaneously measured at five laboratory angles between 30° and 142°, from threshold to 110 MeV. The asymmetry in the angular distribution from 24 to 70 MeV was extracted and found to have sign changes at energies which are in accord with previous experiments. The total photoneutron cross section was observed to be close to the known (γ,p) cross section. From the energy dependence of the asymmetry coefficient a 2$^+$ state in ^{4}He at ≈35 MeV was confirmed. (auth)

17127 QUADRUPOLE SUM RULES FOR ^{4}He. Leonardi, R.; Lipparini, E. (Univ., Bologna). Phys. Lett.; 47B: No. 5, 385-388(10 Dec 1973).

Four simple, remarkably economical and as far as possible rigorous quadrupole sum rules for ^{4}He are derived, discussed and compared with the available experimental results. (auth)

17128 ^{3}H(t,α)2n REACTION AT 40 keV. Larose-Poutissou, R.; Jeremie, H. (Univ. of Montreal). Nucl. Phys.; A218: No. 3, 559-572(1974).

The two-dimensional energy spectrum of the α-particle and the neutron of the ^{3}H(t,α)2n reaction was measured with a small single-gap accelerator at 90 keV. The mean energy of the ^{3}H ions initiating the reaction was estimated to be about 40 keV, i.e., small against the Q-value of 11.3 MeV. It was found that the n–α interaction plays a strong part in the reaction so that no unambiguous determination of a_{n-n}, the n-n scattering length, was possible. The addition of an n–α final-state interaction to the n-n Jost-function enhancement factor in the analysis greatly improves the agreement with the experimental results, but it was not possible to distinguish between various forms of the n–α enhancement factors nor between different combinations of the n–α and the n-n interactions. The failure to obtain a well established n-n interaction peak is attributed to the absence of a direct reaction mechanism. (auth)

17129 PION COUPLING CONSTANT AND PIONIC RADIUS OF ^{3}He. Kopeliovich, B. Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 6, 1157-1163(Dec 1973). (In Russian).

Dispersion relation for the pionic formfactor of He^3 is considered. The subtraction constant is determined from the Goldberger–Treiman relation. Contribution from the abnormal threshold due to the H^3 break-up into the proton–deuteron, as well as proton–singlet deuteron, states is taken into account in the absorptive part. For the ratio of squared pion coupling constants of He^3 and nucleon the quantity is obtained $G^2/g^2 \approx 18$. The pionic radius of He^3 equals to $R_\pi \approx 1.52\ \mu^{-1}$. The charge radius of He^3 is also calculated and a reasonable agreement with the experiment is obtained. (auth)

17130 p^{3}He ELASTIC SCATTERING IN GLAUBER MODEL WITH A SPIN. Lykasov, G. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 6, 1209-1212(Dec 1973). (In Russian).

p^{3}He elastic scattering at $T_p = 600$ MeV is treated in Glauber approximation. The effect of the spin structure of NN interaction amplitude results in better agreement of the theoretical cross section with the experimental one in the large momentum transfer region. The sensitivity of the polarization of the protons and of the recoil nucleus to the ground state wave function of ^{3}He is studied. (auth)

17131 CALCULATION OF ^{3}H, ^{3}He PROPERTIES WITH REALISTIC NN-POTENTIALS IN THE HYPERSPHERICAL BASIS. Demin, V. F.; Pokrovskii, Yu. E. (Atomic Energy Inst., Moscow). Phys. Lett.; 47B: No. 5, 394-396(10 Dec 1973).

^{3}H and ^{3}He properties (the bound energy, the charge radius, S', P and D component weights and others) were calculated using the Reid, Bressel-Kerman-Rouben and supersoft-core potentials. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 16887, 17119, 17122, 17179, 17184, 17196, 17252, and 17315.

17132 (CONF-730134-, pp vp Paper 2) FINITE RANGE AND CLUSTER MODEL DWBA ANALYSIS OF LITHIUM INDUCED SINGLE NUCLEON TRANSFER REACTIONS. Duhm, H. H.; Schumacher, P.; Ueta, N.; Kubo, K. I. (Max-Planck-Institut fuer Kernphysik, Heidelberg). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Form factors and differential cross sections are found in the finite-range and cluster-model DWBA analysis for lithium-6 and -7 elastic scattering and one-nucleon stripping reactions at 34 and 36 MeV. Lithium-6 reactions with carbon-12 and -13, oxygen-16, and magnesium-26 and lithium-7 reactions with carbon-12 and -13, and oxygen-16, and silicon-28. (JFP)

17133 (CONF-730134-, pp vp Paper 4) DYNAMICAL CALCULATION OF THE ABSORPTION IN HEAVY ION REACTIONS. Fink, B.; Toepffer, C. (Univ., Frankfurt am Main). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The effective cross sections are found for the scattering of two bound nucleons in the reaction oxygen-16 + oxygen-16 by averaging the free nucleon–nucleon cross section over momentum densities of the target and projectile and by taking into account the Pauli principle. Also the mean free path length and the imaginary part of the nucleus–nucleus potential are shown. (JFP)

17134 (CONF-730134-, pp vp Paper 5) GENERATOR COORDINATE METHOD FOR HEAVY ION SCATTERING. Fliessbach, T. (Univ., Munich). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The generator coordinate method for the scattering of heavy ions is used to find the total real part of the optical potential and its energy dependence for oxygen-16 reactions with oxygen 16 at 15 and 30 MeV. The trial functions and the optical potential are discussed. It is emphasized that for this approach no special shell model functions are necessary. (JFP)

17135 (CONF-730134-, pp vp Paper 9) PARTIAL WAVE RESONANCES IN THE ^{16}O + ^{16}O SYSTEM. Weidinger, A. (Institut de Physique Nucleaire, Orsay, France). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

A model based on angular momentum mismatch and barrier penetration effects is discussed. The schematic behavior of the partial cross sections for oxygen-16 reactions with oxygen-16 is found. (JFP)

17136 (CONF-730134-, pp vp Paper 20) REACTION MECHANISMS FOLLOWING π^- ABSORPTION ON LIGHT AND MEDIUM NUCLEI. Boschitz, E.; Engelhardt, D.; Lewis, C.; Ullrich, H. (CERN, Geneva). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Gamma spectroscopy was used in order to investigate pion-absorption on nuclei from carbon-12 to niobium-93 at 10 to 220 MeV. The results of these partially analyzed experiments show final states of residual nuclei corresponding to the emission of four (1p,3n) and even eight (3p,5n) nucleons with considerable strength (>1%) and might suggest some absorption mechanism of the π^- on substructures of four or even eight correlated nucleons in the nuclear potential. (JFP)

17137 (CONF-730134, pp vp Paper 32) DENSITY DEPENDENT FORCES IN FINITE NUCLEI WITHOUT THE DETOUR OVER NUCLEAR MATTER. Faessler, A.; Muether, H.; Tripathi, R. K. (Kernforschungsanlage, Juelich, Ger.). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Self-consistent Brueckner–Hartree–Fock calculations were performed in order to present a completely self-consistent micro-

scopic description of the density dependent forces and a completely self-consistent Brueckner–Hartree–Fock calculation with and without the rearrangement terms. The binding energy per nucleon, charge distribution, and the rms charge radius for oxygen-16, and the differential cross sections for electron scattering on oxygen-16 at 374.5 MeV are presented. (JFP)

17138 (LA-5443-C, pp 1-13) EXPERIMENTS IN PION–NUCLEUS PHYSICS. Stroot, J. P. (CERN, Geneva). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

An illustrative review is given of experiments on pion reactions. (JFP)

17139 (LA-5443-C, pp 172-176) DOUBLE-NUCLEON EMISSION FOLLOWING PION ABSORPTION WITH A THREE-BODY DESCRIPTION OF THE FINAL STATE. Garcilazo, H.; Eisenberg, J. M. (Instituto Politecnico National, Mexico City). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

The absorption of a bound negative pion by a nucleus generally results in the emission of two nucleons, thus, with the residual nucleus, forming a three-body system in the final state. The theory of such systems based on the Faddeev equations is presented, and is adapted for use in nuclear reactions leading to the simultaneous emission of two nucleons. Numerical results are presented for double neutron emission following pion absorption in ^{12}C, using one-term separable potentials to simulate the neutron-nucleus interaction to include effects of a repulsive core. The consequences of the nucleon–nucleon short-range correlations inside the nucleus are studied. (auth)

17140 (LA-5443-C, pp 190-192) EXPLICIT "FERMI MOMENTUM" DISTRIBUTION FOR THE ^{12}C GROUND STATE ON THE SHELL MODEL. Ingraham, R. L. (New Mexico State Univ., Las Cruces). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

Approximate treatments of the π-nucleus optical potential usually choose, on esthetic or other aribtrary grounds, some "mean" nucleon momentum to use in the π-nucleon t-matrix element. The nuclear overlap integral $F_0(\vec{p}-\vec{q},\vec{p})$ for the ground state of ^{12}C is calculated explicitly on the shell model to find out at which nucleon momentum $\vec{p}$, for a given momentum transfer $\vec{q}$, F_0 really peaks. This value differs from those mean values usually seen in the literature. A prescription for the optimum "mean" nucleon momentum is suggested. (auth)

17141 (LA-5443-C, pp 212-217) NUCLEAR GAMMA RAYS FROM 220-MeV π^--NUCLEAR SCATTERING EXPERIMENTS ON A = 12 TO A = 51 NUCLEI. Lind, V. G. (Utah State Univ., Logan); Plendl, H. S.; Funsten, H. O. Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

Pion reactions are studied by observing the prompt gamma emission from nuclides left in excited states resulting from the interaction. Data obtained with 245-MeV negative pions on carbon-12, oxygen-16, fluorine-19, magnesium-24, aluminum-27, silicon-28, sulfur-32, calcium-40, and vanadium-51 are presented on the gamma spectra and cross sections. (JFP)

17142 (LA-5443-C, pp 218-225) POSITIVE PION PRODUCTION BY PROTONS. Miller, G. A. (Carnegie-Mellon Univ., Pittsburgh). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

A model is used in which the pion is produced by an incident proton to examine the $^{12}C(p,\pi^+)^{12}C$ and $^9Be(p,\pi^+)^{10}Be$ reactions at 185 MeV. The recent Uppsala data is fit with a DWBA calculation which takes the pion's distortion from the Kisslinger potential. This is the first calculation in which the same optical potential is used to fit both the elastic and (p,π^+) data; and which also uses the free pion–nucleon coupling constant at the interaction vertex. This reaction is also sensitive to details of nuclear structure because of the large momentum transfer involved. Components of the final nucleus which consist of a single particle of high angular momentum coupled to an excited state of the target may play an important role in this process. Such components are taken into account by considering a (p,p') reaction which excites the target. The pion is then emitted by the p'. In a detailed calculation it is shown that for pion production at 185 MeV this effect produces a 10% decrease in the cross section. In a more approximate treatment, it is also shown that at higher energies this two-step process is very important. (auth)

17143 (LA-5443-C, pp 237-244) RESONANCE TWO-STEP MECHANISM AND THE CHARGE DEPENDENCE OF $(\pi,\pi N)$ REACTIONS. Strobel, G. L. (Univ. of Georgia, Athens). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

Deviations of the ratio R for $\sigma(\pi^+, \pi^+n \text{ or } \pi^0p)/\sigma(\pi^-, \pi^-n)$ from the impulse approximation predictions are explained by including a two-step nucleon–nucleus resonance reaction mechanism. Such a mechanism dominates the 50-MeV (p,2p) reaction on ^{16}O. In this mechanism the pion interacts with a nucleon, which is excited into a giant resonance state with the nucleus. This resonant state decays into the final state, emitting a nucleon. Depending on the relative importance of this mechanism, R can vary from the impulse value of $\frac{1}{4}$ to a maximum of $\frac{9}{4}$ in this model. Resonance parameters are used which are consistent with values from proton induced reaction analyses. The calculated R reproduces the trends of the experimental values. The decrease in cross section from ^{12}C to ^{16}O is also reproduced. The ratio of $\sigma(\pi^-, \pi^+n)/\sigma(\pi^-, \pi^-p)$ on a ^{12}C target is calculated to be 1.12 which compares well with the experimental value of 1.3 ± 0.4. (auth)

17144 ANGULAR DISTRIBUTIONS OF NEUTRONS IN $^9Be + d$ REACTION LEADING TO 1.75- AND 2.20-MeV STATES OF ^{10}B. Srivastav, M. L.; Sah, J. P. (Lucknow Univ., India). Indian J. Pure Appl. Phys.; 11: No. 5, 361-363(May 1973).

The angular distribution of neutrons corresponding to 1.75 and 2.20 MeV levels of ^{10}B are calculated and explained by the interference effect of deuteron stripping and heavy-particle stripping processes. In the forward direction, destructive interference takes place while in the backward direction their effect is constructive. (auth)

17145 BRUECKNER SELF-CONSISTENT STUDY OF ^{16}O AND ^{40}Ca USING PHASE-SHIFT DETERMINED POTENTIALS. Hodgson, R. J. W.; Hoang, T. D. (Univ. of Ottawa). Can. J. Phys.; 51: No. 2, 115-120(15 Jan 1973).

A self-consistent Brueckner calculation of the binding energy and single-particle energies of ^{16}O and ^{40}Ca is carried out employing an effective interaction which is determined directly from the two-body scattering data. The interaction is described by its harmonic-oscillator matrix elements. It is found that the results are quite sensitive to the form of the phase shift at high energies. (auth)

17146 LEVELS OF NEGATIVE PARITY OF ^{16}O BEGINNING WITH THREE-BODY FORCES. Saunier, G. (Univ. of Montreal); LeTourneux, J.; Rouben, B.; Padjen, R. Can. J. Phys.; 51: No. 6, 629-633(15 Mar 1973). (In French).

Tamm–Dankoff and RPA calculations of the odd excited states of ^{16}O were performed on the Hartree–Fock basis, using various effective interactions in which a Skyrme-type three-body term simulates the density dependence. It is shown that although these forces lead to good results for the HF ground state they are not appropriate for odd parity excited states. In particular if the strength of the three-body term is too great, the 2^- level becomes imaginary. This in fact occurs for the interaction Vautherin–Brink I, which shows that the spherical HF solution with this force is unstable. (auth)

17147 EVIDENCE FOR THE $1\frac{1}{2}^-$ MEMBER OF THE $K = \frac{1}{2}^-$ BAND IN ^{19}F. Rogers, D. W. O. (Univ. of Toronto); Dixon, W. R.; Storey, R. S. (Univ. of Toronto). Can. J. Phys.; 51: No. 1, 1-8 (1 Jan 1973).

A new resonance at 3993 ± 2 keV was found in the $^{15}N(\alpha,\gamma)^{19}F$ reaction corresponding to a level at 7165.7 ± 1.0 keV in ^{19}F which decays primarily to the $\frac{3}{2}^-$ level at 4032 keV ($94 \pm 2\%$) and weakly to the $\frac{1}{2}^-$ level at 3999 keV ($6 \pm 2\%$). The decay scheme, angular distributions, and radiative width ($\omega\gamma = 1.15 \pm 0.23$ eV) together with some crude estimates of α widths imply J^π is most likely $1\frac{1}{2}^-$. The lifetime of the $\frac{3}{2}^-$ level was measured using the DSAM to be $\tau = 87 \pm 16$ fs. The decay properties of the $1\frac{1}{2}^-$ and $\frac{3}{2}^-$ levels agree well with the predictions for the $1\frac{1}{2}^-$ and $\frac{3}{2}^-$ members of the $K = \frac{1}{2}^-$ band in ^{19}F. (auth)

17148 NEUTRON YIELD FROM Li, Be, Co, AND Cu UNDER PROTON BOMBARDMENT AT ENERGIES FROM 5 TO 10 MeV. Atta, M. A.; Scott, M. C. (Univ. of Birmingham, Eng.). J. Nucl. Energy; 27: No. 12, 875-884(Dec 1973).

A continuous flow vanadium bath was used to measure the neutron yield from different accelerator targets, and the correction factors which have to be applied are discussed. The results of yield measurements for protons from 5 to 10 MeV on thick targets of Li, Be, Cu, and Co are given and compared with calculated values. Based on these comparisons comments are made on the accuracy of the cross sections used in the yield calculations. (auth)

17149 SHELL MODEL CALCULATIONS ON NATURAL PARITY STATES IN $10 \leq A \leq 14$ NUCLEI. Saayman, R.; de Kock, P. R.;

van der Merwe, J. H. (Stellenbosch Univ., South Africa). Z. Phys.; 265: No. 1, 69-85(Oct 1973).

Shell model calculations of natural parity states in the $10 \leq A \leq 14$ mass region have been performed by assuming an inert ^{4}He core with the residual interaction in the 1p shell only. The modified surface delta interaction (MSDI) has been used as an effective two-body interaction. The MSDI parameters as well as the single-particle binding energies have been deduced from a least-squares fit to experimentally known levels in, firstly, the separate ^{10}B, ^{11}B–C, ^{12}C, ^{13}C–N and ^{14}N nuclei, and secondly the whole mass region $10 \leq A \leq 14$. Multipole moments for ground states and M1 and E2 radiative widths for excited states have been calculated with the resultant wave functions. (auth)

17150 ANGULAR DISTRIBUTIONS OF PROTONS FROM BREMSSTRAHLUNG OF MAXIMUM ENERGY 400 MeV INCIDENT ON ELEMENTS BETWEEN LITHIUM AND GOLD. Dougan, P.; Stiefler, W. (Univ. of Lund, Sweden). Z. Phys.; 265: No. 1, 1-31 (Oct 1973).

The cross sections for photo-proton emission from Li, Be, C, O, Al, Ca, Cu, Ag and Au irradiated with bremsstrahlung of maximum energy 400 MeV have been determined for proton energies in the range 80 to 280 MeV at laboratory angles between 14 and 130°. A qualitative examination of the data is made to determine whether or not they agree with the predictions of the quasi-deuteron model. (auth)

17151 POSSIBLE ALPHA-PARTICLE CLUSTER ABSORPTION OF PIONS BY ^{16}O. Lewis, C. W.; Ullrich, H.; Engelhardt, H. D.; Boschitz, E. T. (CERN, Geneva). Phys. Lett.; 47B: No. 4, 339-341(26 Nov 1973).

It is shown that ^{12}C 4.44 MeV γ-rays result from π^- absorption at rest in ^{16}O. The ^{12}C recoil momentum distribution was determined from the Doppler-broadening and compared with (p,pα) measurements on ^{16}O. (auth)

17152 NEW STATES IN ^{16}F. Bohne, W.; Fuchs, H.; Grabisch, K.; Hilscher, D.; Jahnke, U.; Kluge, H.; Masterson, T. G. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Phys. Lett.; 47B: No. 4, 342-344(26 Nov 1973).

Ten new states in ^{16}F have been identified through an investigation of the reaction ^{14}N(τ,n)^{16}F. For several levels J^π and/or transition L-values have been deduced. (auth)

17153 POLARIZATION OF NEUTRONS ELASTICALLY SCATTERED FROM ^{16}O. Hickey, G. T.; Firk, F. W. K.; Holt, R. J.; Nath, R.; Schultz, H. L. (Yale Univ., New Haven). Phys. Lett.; 47B: No. 4, 348-350(26 Nov 1973).

A high-resolution study of the polarization of neutrons elastically scattered from ^{16}O has been made at nine angles between 1 and 4 MeV and a preliminary phase-shift analysis of the results has been carried out. The experiment used an intense source of polarized neutrons generated via the reactions ^{238}U(γ,n)^{237}U → ^{12}C(n,$\vec{n}$)^{12}C. (auth)

17154 THREE-BODY MODEL FOR HEAVY ION REACTIONS USING PROJECTION OPERATORS. Osman, A. (Univ., Cairo). Atomkernenergie; 22: No. 1, 62-66(Sep 1973).

Heavy ion reactions with nucleon transfers have been considered on a three-body model basis. To avoid the nonorthogonality between the different channels in these reactions, projection operators are introduced. Thus, a set of distorted three-cluster wave functions is constructed which includes the distortion effects. The calculated angular distributions are in good and reliable agreement with the experimental data. (GE)

17155 FRAGMENTATION OF RELATIVISTIC HEAVY IONS. Feshbach, H.; Huang, K. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 47B: No. 4, 300-302(26 Nov 1973).

The "incoherent droplet model" is used to explain recent experiments on the fragmentation of ^{16}O during high energy collision with a Be target. In the ^{16}O rest frame the fragments have a universal isotropic Gaussian momentum distribution, independent to the masses of the fragments. The half-width of the Gaussian is $\langle p^2 \rangle$ (A/3n), where A is the mass number of the nucleus, n is the total number of fragments, and $\langle p^2 \rangle$ is the mean square momentum of individual nucleons in the fragmenting nucleus. (auth)

17156 CALCULATIONS OF THE SHAPES AND POSITIONS OF THE TWO-PARTICLE RESONANCE PEAKS IN THE ENERGY DISTRIBUTIONS OF THREE-PARTICLE NUCLEAR REACTIONS. Komarov, V. V.; El'-Takhavi, M. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1681-1683(Aug 1973). (In Russian).

An analysis was made of the α particle spectrum from the ^{11}B(p,α) reaction at incident proton energies of 2.00 and 2.65 MeV, which corresponds with the excited states of 17.77 and 18.37 MeV of ^{12}C. The α coincidence spectra were calculated and compared with experimental data. (JSR)

17157 STUDY OF THE INTERACTION OF LOW-ENERGY PROTONS WITH ^{9}Be NUCLEI. Mashkarov, Yu. G.; Deineko, A. S.; Zalyubovskii, I. I.; Slabospitskii, R. P.; Bezvershuk, B. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1729-1732 (Aug 1973). (In Russian).

In order to study the excited states of ^{10}B and to verify the model representation a study was made of the interaction of polarized and nonpolarized protons with ^{9}Be in the energy range from 1.9 to 3 MeV. The relative yield of elastically scattered protons was measured simultaneously at 120, 140, and 160°. The yield of α particles in the ^{9}Be(p,α) reaction was determined at 60°. Anomalies in the excitation function were observed at E_p = 2.350, 2.430, 2.545, 2.560, 2.610, and 2.720 MeV. The dependence of the polarization of scattered protons on the proton energy was shown. The angular dependence of the polarization of the elastic scattering of protons was also shown. Measurement of the angular scattering cross section weak anomalies was observed near the threshold. (JSR)

17158 PERTURBATIVE APPROXIMATIONS TO THE EFFECTIVE HAMILTONIAN IN THE PRESENCE OF AN INTRUDER STATE. Vincent, C. M.; Pittel, S. (Univ. of Pittsburgh). Phys. Lett., 47B: No. 4, 327-331(26 Nov 1973).

Perturbative approximations to the effective Hamiltonian for $J^\pi = 0^+$, T = 1 states in ^{18}O are studied through 4th order, in the context of an 8 × 8 Hamiltonian matrix. Comparison of the results with exact effective matrix elements indicates that low-order perturbation theory provides a good approximation, even though the perturbation series is divergent. This success was explained by showing that the singularity which causes the divergence has a negligible influence on low-order perturbation theory, because the intruder state and the uppermost model state interact weakly. (auth)

17159 SEQUENTIAL REACTION: INFLUENCE OF DIFFERENT PARAMETERS. Goulard, G. (Coll. Militaire Royal de Saint-Jean, Quebec). Can. J. Phys.; 51: No. 21, 2233-2241(1 Nov 1973). (In French).

Given a sequential reaction at low energies A + B → C* → D + G* → D + E + F, one previously derived a cross section formula which corresponds to the detection of two final-state particles. In this expression of σ_L some energy-dependent terms appear which are related to the relative motion of D–G* and E–F. The influence on the absolute value of σ_L is studied for the special reaction ^{11}B + p → 3α at incident energies of 2.65 MeV and 163 keV and also the variations of σ_L with the parameters of α–α scattering. (auth)

17160 HIGH-ENERGY LEVELS IN ^{13}N. Measday, D. F. (Univ. of British Columbia, Vancouver); Hasinoff, M.; Johnson, D. L. Can. J. Phys.; 51: No. 11, 1227-1237(1 Jun 1973).

A natural carbon target was bombarded by protons in the energy range E_p = 9 to 24 MeV (E_x = 10 to 24 MeV in ^{13}N). High energy γ rays were detected in a NaI crystal oriented at 90° to the beam direction. Excitation functions were obtained for the 12.71 and 15.11 MeV γ rays from inelastic scattering on ^{12}C and for capture γ rays from the reaction ^{12}C(p,γ_0)^{13}N. New structure is reported for all these reactions. (auth)

17161 M1 TRANSITIONS IN THE REACTION ^{6}Li(γ,^{2}H)^{4}He. Passler, K. H. (Univ., Giessen, Ger.). Z. Naturforsch., 28A: No. 1, 8-11(Jan 1973).

It is shown that the admixture of a D-state in the wave function for the relative motion of the α-particle and the deuteron in the nucleus ^{6}Li leads to M1 transitions. Their mixture with E2 transitions does not lead to an asymmetry of the differential cross section of the reaction ^{6}Li(γ,^{2}H)^{4}He about 90°, and they are negligibly small. (GE)

17162 SOLAR-NEUTRINO RELATED M1 TRANSITION IN ^{8}Li. Werntz, C.; Ueberall, H. (Catholic Univ. of America, Washington, DC). Z. Phys.; 265: No. 4, 405-410(Nov 1973).

A two-cluster model is devised for the hypothetical 0^+, T = 1 level at 11.5 MeV in ^{8}Be which was proposed to explain the low value of the observed flux of high energy solar neutrinos. It is used to show that searches for this level as carried out by means of inelastic electron scattering have not been conclusive, and could be improved to a limited degree only. (GE)

17163 AXIAL ASYMMETRY AND THE SPECTRUM OF ^{16}O. Larsson, S. E. (Lund Inst. of Tech., Sweden); Leander, G.; Nilsson, S. G.; Ragnarsson, I.; Sheline, R. K. Phys. Lett.; 47B: No. 5, 422-426(10 Dec 1973).

The triaxial harmonic oscillator is found to be associated with a shell gap for nucleon number 8 corresponding to oscillator frequency ratios 3 : 2 : 1 and a deformation $\gamma = 30°$, $\epsilon = 0.87$. The experimental positive-parity spectrum of ^{16}O is interpreted in terms of an anharmonic ground state vibrational spectrum on

which is superimposed 3:2:1 triaxial bands. The moment of inertia of the latter are found to agree well with expectations. There is also empirical evidence for an extremely deformed band at about 17 MeV, that might be associated with a 4:1 shell structure. (auth)

17164 PION PRODUCTION ON ^{12}C BY 185-MeV PROTONS. Dahlgren, S.; Grafstroem, P.; Hoeistad, B.; Asberg, A. (Uppsala Univ.). Phys. Lett.; 47B: No. 5, 439-441(10 Dec 1973).

Energy spectra of pions produced in the two reactions $^{13}C(p,\pi^+)^{14}C$ and $^{13}C(p,\pi^-)^{14}O$ at E_p = 185 MeV were measured in the angular regions 15°–130° (lab) and 35°–130° (lab), respectively. Angular distribution for proton capture leading to the ground states in ^{14}C and ^{14}O was determined. (auth)

17165 $^{12}C + ^{12}C$ ELASTIC AND INELASTIC SCATTERING AT 114 AND 174 MeV. Anyas-Weiss, N.; Becker, J. A.; Belote, T. A.; Cornell, J. C.; Fisher, P. S.; Hudson, P. N.; Menchaca-Rocha, A.; Panagiotou, D. A.; Scott, D. K. (Nuclear Physics Lab., Oxford). Phys. Lett.; 47B: No. 5, 442-444(10 Dec 1973).

The elastic and inelastic scattering of ^{12}C by ^{12}C was studied at 114 and 174 MeV. Relative cross sections for the excitation of one or both ^{12}C ions are compared with the semi-classical theory of Brink. In contrast to earlier results no excitation was observed of states above 20 MeV. (auth)

17166 REACTION $^{12}C(^{16}O,^{20}Ne)^8Be$ AND THE STRUCTURE OF ^{20}Ne. Yoshida, H. (Osaka Univ.). Phys. Lett.; 47B: No. 5, 411-414(10 Dec 1973).

Finite-range DWBA calculations are performed here for the reaction $^{12}C(^{16}O,^{20}Ne)^8Be$ populating the ground-state rotational band of ^{20}Ne. Angular shapes are reproduced fairly well by the shell model configuration of $(sd)^4$ for ^{20}Ne. (auth)

17167 FLUCTUATION ANALYSIS OF THEORETICAL $^{12}C-^{12}C$ CROSS SECTIONS. Jansen, K.; Scheid, W. (Univ., Frankfurt am Main). Phys. Lett.; 47B: No. 5, 427-429(10 Dec 1973).

Theoretical excitation functions of elastic and inelastic scattering of ^{12}C on ^{12}C, obtained by a coupled channel calculation, are analyzed in the framework of the theory of compound fluctuations. It is found that direct contributions are partially analyzed as compound contributions. (auth)

17168 HEAVY-ION REACTION CHANNELS OF THE SYSTEM $^{16}O + ^{16}O$. Rossner, H. H.; Hinderer, G.; Weidinger, A.; Eberhard, K. A. (Univ., Munich). Nucl. Phys.; A218: No. 3, 606-620(1974).

The reaction channels of the system $^{16}O + ^{16}O$ with outgoing heavy particles from lithium to magnesium were measured using a ΔE-E telescope. Excitation functions from 49 to 65 MeV at θ_{Lab} = 30° and angular distributions from θ_{Lab} = 10 (20) to 50° at E_{Lab} = 51.5 MeV are presented for the strong transitions. The excitation function of the $^{12}C-^{20}Ne$ (4.25 MeV) channel shows a pronounced regular cross structure with peaks at 52 and 60 MeV. A selective excitation of certain states in the inelastic scattering and the $^{12}C-^{20}Ne$ channel is observed, the yields of the other heavy-ion channels being weaker by at least one order of magnitude. An explanation of this phenomenon is given by considering the angular momentum matching between entrance and exit channels. Furthermore it is shown that no strong dependence of the cross sections on the transferred angular momentum or on the nuclear structure of the final states is observed. Possible implications of these results on the reaction mechanism are discussed. (auth)

17169 SPIN-DEPENDENCE AND COHERENT SUMMATIONS IN TWO-NUCLEON TRANSFER REACTIONS. Nelson, J. M. (Univ. of Birmingham, Eng.); Falk, W. R. Nucl. Phys.; A218: No. 3, 441-460(1974).

The differential cross sections of the $^{19}F(p, ^3He)^{17}O$ and $^{19}F(p,t)^{17}F$ reactions leading to the ground and first three excited states were measured at an incident energy of 42.4 MeV. The polarization analyzing powers of two of the (p, ^{3}He) reactions were measured at a higher energy of 49.5 MeV with a polarized incident beam. The experimental results were analyzed in terms of conventional DWBA theory, and the importance of interference terms arising from the proper coherent summations contained in the definition of the differential cross section and analyzing power, was investigated. It is found that the interference term arising from the coherent summation over the transferred spin S is significant and should not normally be neglected. (auth)

17170 INTERMEDIATE STRUCTURE OF THE $^{12}C + \alpha \rightarrow 4\alpha$ REACTION. Rutkevich, N. Ya.; Klyucharev, A. P.; Kuz'michev, M. A.; Linetskii, A. R. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1697-1701 (Aug 1973). (In Russian).

The reaction of the complete decay of the ($^{12}C + \alpha$) system, excited at energies of 20 to 35 MeV, into α particle fragments was studied. Some reaction channels were isolated and their relative contributions were evaluated. The energy distribution was obtained. (tr-auth)

17171 EFFECTS OF SCALING INVARIANCE IN BACKWARD PROTON–NUCLEUS SCATTERING AT ENERGIES OF FEW GeV. Bayukov, Yu. D.; Vorob'ev, L. S.; Leksin, G. A.; Stolin, V. L.; Fedorov, V. B.; Khovanskii, V. D. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 6, 1246-1250(Dec 1973). (In Russian).

Considering previously measured spectra of protons emitted from nuclei under the angle of 137° in lab. system at the incident proton energy from 1.15 up to 5.7 GeV some data are obtained indicating an effect analogous to the scaling in the high energy particle scattering on protons. (auth)

17172 ANGULAR $\alpha\gamma$ CORRELATIONS AT INELASTIC α-PARTICLE SCATTERING. Dmitrieva, T. A.; Zelenskaya, N. S.; El'Kamkhavi, A. A.; Teplov, I. B. (Moscow State Univ.). Yadern. Fiz.; 18: No. 6, 1223-1231(Dec 1973). (In Russian).

Angular correlation function between the final particles and γ quanta at inelastic α-particle scattering on light nuclei is analyzed in the total region of emission angles for the simplest direct mechanisms: knock-on and stripping of heavy particle. The reaction $^{12}C(\alpha, \alpha'\gamma)^{12}C$ was considered as the example. The theoretical correlation functions are shown to be in reasonable agreement with the experiment at the angles sufficiently small ($\theta_\alpha < 60°$) and large ($\theta_\alpha > 150°$). It is noted that at $\theta_\alpha \sim 90°-110°$ and small θ_γ the theoretical curves for the heavy-particle stripping mechanism deviate from the usual form $A + B\sin^2 2(\theta_\gamma - \theta_\phi)$; the reason for such deviations is presented. It is shown that the heavy-particle stripping provides a qualitative explanation of a "rotation" of correlations, i.e., of the angle θ_ϕ jumps depending on the incident particle energy E_α and on the final particle emission angle θ_α. (auth)

17173 INELASTIC INTERACTIONS AND THE PROTON STRIPPING FOR THE 9.4 GeV/c DEUTERONS IN PHOTOEMULSION. Vaisenberg, A. O.; Kolganova, E. D.; Rabin, N. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 6, 1239-1245(Dec 1973). (In Russian).

The inelastic interaction of the deuterons (of 9.4 GeV/c momentum) with light and heavy emulsion nuclei was studied. The various characteristics of stars are obtained and the proton stripping events are isolated. The free deuteron path in the emulsion has appeared to be 25.6 ± 1 cm. The deuteron inelastic cross sections are equal to $\sigma_{(C,N,O)}$ = 340 ± 30 mb; $\sigma_{(Ar,Br)}$ = 1440 ± 70 mb. The proton stripping cross sections for the deviation angles less than $2 \cdot 10^{-2}$ are equal to $\sigma_{(C,N,O)}$ = 43 ± 10 mb; $\sigma_{(Ar,Br)}$ = 145 ± 17 mb. The angular distributions of the stripping protons are presented and the obtained results are discussed. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 15708, 17132, 17136, 17138, 17141, 17150, 17166, 17252, and 17315.

17174 (CONF-730134-, pp vp Paper 7) MICROSCOPIC STUDY OF INELASTIC SCATTERING REACTION INDUCED BY HEAVY-ION COLLISION. Kubo, K. I.; Dragun, O.; Duhm, H. H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The characteristic features of the microscopic study of the charge-exchange process $^{25}Mg(^6Li,^6He)^{25}Al$ at 36 MeV, which may be interpreted as a recoupling process of a hole configuration, are discussed. The form factors, differential cross sections, and angular distributions are considered. (JFP)

17175 (CONF-730134-, pp vp Paper 35) PHASE TRANSITION IN THE ROTATIONAL STATES OF LIGHT NUCLEI. Goeke, K.; Muether, H.; Faessler, A. (Kernforschungsanlage, Juelich, Ger.). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The decrease of the pairing correlations with increasing angular momentum is studied by an angular momentum projection from Hartree–Bogoliubov states, performed approximately before the variation. This is done in the framework of a constrained Hartree–Bogoliubov method with the pairing energy as a constrained quantity. The excitation energies, strong decrease of the moment of inertia with increasing angular momentum, the emission spectrum, and the strong decrease of the pairing energy with increasing

angular momentum and a sudden change of its order of magnitude are studied for neon-22. (JFP)

17176 (CONF-730134-, pp vp Paper 36) FACTORIZATION SCHEMES OF THE NUCLEUS AND STRUCTURE OF THE FRAGMENTS. Gomez, J. M. G. (Univ. of Copenhagen). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

A description of nuclear systems in terms of factorized substructures is discussed. The structure of the interacting fragments is investigated by a variational method. The fragmentation of a system in weakly and strongly interacting substructures is studied. Calculations in the s-d shell are compared with exact shell-model calculations, illustrating the drastic reductions in dimensionality achieved with the factorization schemes. (auth)

17177 (COO-2174-15, pp vp 6p) RESULTS FOR ARGON. Jun 1973.

In neutron velocity spectroscopy using the Nevis synchrocyclotron.

17178 PROBABILITIES OF ELECTROMAGNETIC TRANSITIONS IN THE ^{23}Na NUCLEUS. Kopanets, E. G.; Koval, A. A.; Kostin, V. Ya.; L'vov, A. N.; Migalenya, V. Ya.; Tsytko, S. P. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1739-1741(Aug 1973). (In Russian).

The angular distribution of the γ emission excited during the decay of states with excitation energy of 10.014, 10.171, 11.084, and 11.108 MeV was measured with a Ge(Li) detector. The matrix elements of the electromagnetic transitions were calculated for 22 γ transitions for which the mixing coefficients were determined. A comparison of three experimental matrix elements for analog-antianalog transition with theoretical values showed good agreement. The decay scheme is given for some excited states of ^{23}Na. (JSR)

17179 STUDY OF THE (p,p') AND (p,d) REACTIONS WITH POLARIZED PROTONS ON ISOTOPES OF SULFUR AND SOME OTHER LIGHT AND INTERMEDIATE NUCLEI. Gosset, J.; Kamitsubo, H.; Lombard, R. M.; Mayer, B.; Plavko, A. V.; Thirion, J.; Escudie, J. L. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1721-1728(Aug 1973). (In Russian).

Experimental data obtained previously on (p,p') and (p,d) reactions with polarized protons on ^{32}S, ^{34}S, ^{92}Mo, ^{92}Zr, ^{93}Zr, ^{40}Ca, ^{64}Ni, ^{28}Si, ^{16}O, ^{12}C, ^{31}S, and ^{33}S were analyzed and differential cross sections and angular distribution of the asymmetry of the proton inelastic scattering were determined. (JSR)

17180 MEASUREMENT OF THE CONTINUOUS ENERGY DEPENDENCE OF TRIPLE CHARGED PARTICLE–γ QUANTA ANGULAR CORRELATIONS. Vasil'ev, S. S.; Dem'yanova, A. S.; Zazulin, V. S.; Kostyuchenkov, S. D.; Mikhaleva, T. N.; Chuprunov, D. L.; Shishkin, K. S. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1708-1710(Aug 1973). (In Russian).

A method is proposed for the measurement of the continuous energy dependence of ternary angular correlations of charged particles–γ quanta. The method is based on the formulation of excitation functions as a function of the energy dispersal of the beam, dispersal of the statistical character of the energy loss in the target, resolving capacity of the detector, and energy dispersal of the scattered particles from a measurement of the coincidence spectrum from the particles scattered on a thick target. As an illustration of the method the energy dependence of the angular correlation during excitation was measured in the inelastic scattering of the 2^+ level of ^{24}Mg and ^{28}Si. (JSR)

17181 MECHANISM OF THE REACTION ^{31}P(d,α)^{29}Si AT $E_d < 4.0$ MeV. Vysotskii, G. L.; Zalyubovskii, I. I.; Kuznichenko, A. V.; Lobkovskii, A. P.; Ustimenkov, K. F.; Zabegai, V. M.; Melenevskii, A. E.; Nemets, O. F.; Nemykin, V. I. Kharkov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1633-1641(Aug 1973).

A clarification of the possible mechanism of the ^{31}P(d,α)^{29}Si reaction was attempted. With this purpose in addition to an analysis of the angular distribution of the α particles, a variational analysis was made of the measured excitation functions. In addition to information on the reaction mechanism, data were obtained on the compound nucleus ^{33}S at excitation energy of $E_{ex} \sim$ 19 MeV and the quantum characteristics of the 3.07, 3.62, and 4.08 MeV levels of the final nucleus ^{29}Si were confirmed. (JSR)

17182 MECHANISM OF THE ^{30}Si(d,p) REACTION AT LOW DEUTERON ENERGIES. Zalyubovskii, I. I.; Ustimenkov, K. F. (Kharkov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1642-1651(Aug 1973). (In Russian).

Using experimental data previously obtained an attempt is made to describe some angular distribution of the protons by means of the distorted wave theory with nonlocal wave functions. A variational analysis of the excitation functions is described and the average width of the levels of ^{32}P in the excitation range from 14.5 to 15.5 MeV is determined. A comparison is made of the excitation functions averaged to $\Delta E = 600$ keV and the angular distribution with corresponding magnitudes which are represented in the form $\sigma = \sigma_{pr} + \sigma_{com}$ where σ_{pr} is the cross section of the direct interaction and σ_{com} is the mean cross section of the reaction with formation of the compound nucleus. Other possible mechanisms of this reaction are discussed. (JSR)

17183 EXCITATION OF THE GROUND-STATE ROTATIONAL BAND IN ^{28}Si BY INELASTIC SCATTERING OF 25.25 MeV POLARIZED PROTONS. de Swiniarski, R. (Inst. de Sciences Nucleaires, Grenoble-Cedex, France); Conzett, H. E.; Lamontagne, C. R.; Frois, B.; Slobodrian, R. J. Can. J. Phys.; 51: No. 12, 1293-1299(15 Jun 1973).

Angular distributions of the analyzing power and cross sections were measured for the elastic and inelastic scattering of 25.25-MeV protons exciting the $K = 0^+$ ground-state band in ^{28}Si. Good agreement with experiment is obtained in the coupled-channels formalism on the basis of the rotational model with a quadrupole deformation $\beta_2 = -0.40$ (oblate) and a hexadecapole deformation $\beta_4 = +0.15$. The calculations show the great sensitivity of the experimental results to both the magnitude and sign of the quadrupole and hexadecapole deformations. Equivalent fits of the data were obtained either by keeping the deformation length of the various deformed terms of the optical potential constant ($\delta_0 = \beta_0 R_0 = \beta_1 R_1 = \beta_{LS} R_{LS}$) or by increasing the deformation of the spin–orbit optical potential relative to the central potential by a factor of 1.5 ($\beta_{LS} = 1.5\beta_{cent}$). (auth)

17184 HIGH-SPIN STATES IN ^{23}Na. Frank, G. G.; Elliott, R. V.; Spear, R. H.; Kuehner, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 11, 1155-1169(1 Jun 1973).

The ^{12}C(^{12}C,pγ)^{23}Na reaction was used to study the γ-ray deexcitation of levels up to $E_x = 10.4$ MeV in ^{23}Na. Doppler-shift attenuation measurements yielded mean lifetimes or lifetime limits for 22 levels. Branching ratios were obtained for the 5.54, 6.11, 6.24, and 6.35 MeV levels and the major modes of decay were observed for 7 levels above $E_x = 7$ MeV. Angular distributions were measured for γ rays in coincidence with proton groups corresponding to the 5.54, 6.11, 6.24, 6.35, 9.04, and 10.35 MeV levels. The 6.35 MeV level is assigned a spin and parity of $\frac{5}{2}^-$ and interpreted as a member of the low-lying $K^\pi = \frac{1}{2}^-$ band in ^{23}Na. Levels at 9.04 and 10.35 MeV are interpreted as the $\frac{1}{2}^+$ and $\frac{3}{2}^-$ members of the ground-state rotational band and $K^\pi = \frac{1}{2}^-$ band, respectively. The experimental γ-ray transition strengths in ^{23}Na are compared to those predicted by the Nilsson model including band mixing. The M1 strengths are modified to account for the effects of isospin. (auth)

17185 GAMMA-RAY LINEAR-POLARIZATION AND ANGULAR-DISTRIBUTION FORMULAS FOR MIXTURES OF THREE MULTIPOLES. Vaillancourt, R.; Taras, P. (Univ. of Montreal). Nucl. Instrum. Methods; 114: No. 2, 333-340(1974).

Gamma-ray linear-polarization and angular-distribution formulas for mixtures of three multipoles are presented in terms of the phase-defined reduced matrix elements of Rose and Brink. These formulas are applicable to the simple angular distribution as well as to the particle–gamma angular correlation known as Method II of Litherland and Ferguson. In addition, a "recipe" was worked out for transforming an angular distribution formula into a linear polarization formula in the general case of a γ radiation consisting of an arbitrary number of multipoles. (1 figure, 1 table) (auth)

17186 ANGULAR MOMENTUM DEPENDENCE IN 22 MeV α-PARTICLE ELASTIC SCATTERING BY LIGHT NUCLEI. Lega, J.; Macq, P. C. (Univ., Louvain, Belg.). Nucl. Phys.; A218: No. 3, 429-440(1974).

Elastic scattering of 22 MeV α-particles by ^{23}Na, ^{24,25,26}Mg, ^{27}Al and ^{28}Si was measured between 24 and 174° lab. Partial angular distributions, from 120 to 174°, were also measured at incident energies of 18.4 and 20.7 MeV for ^{24}Mg, and 18.9 and 20.5 MeV for ^{28}Si. The most striking feature of the data is the large-angle behavior: spin-zero nuclei display more pronounced backward oscillations and the cross section rises more steeply towards 180° for 4n nuclei than for the others. Optical model analyses with an l-dependent absorption and a minimum of free parameters are used to describe the general trend of the data for A = 23 to 28 nuclei at different energies; a spin-orbit coupling term, 2.75 MeV deep, is added to describe the ^{23}Na scattering data. (auth)

17187 PROBABILITY OF E2 TRANSITIONS IN DEFORMED ODD NUCLEI WITH AN sd SHELL. Salakhitdinov, A. N.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 5, 28-31(1973). (In Russian).

The reduced probabilities of E2 transitions were calculated for low-lying states of ^{21}Ne, ^{25}Mg, ^{27}Al, ^{33}S, and ^{39}K. (JSR)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 15708, 17111, 17136, 17138, 17141, 17145, 17148, 17150, 17179, 17187, 17212, 17252, 17267, and 17315.

17188 (ANL/NDM-3) NEUTRON SCATTERING FROM TITANIUM: COMPOUND AND DIRECT EFFECTS. Barnard, E.; deVilliers, J.; Moldauer, P.; Reitmann, D.; Smith, A.; Whalen, J. (Argonne National Lab., Ill. (USA)). 1 Oct 1973. Contract W-31-109-eng-38. 39p. Dep. NTIS $4.00.

Neutron total and elastic- and inelastic-scattering cross sections of natural titanium were measured. Total cross sections were determined from 0.1 to 1.5 MeV with resolutions of $\gtrsim 1.5$ keV. Differential elastic and inelastic neutron scattering cross sections were measured from 0.3 to 1.5 MeV with resolutions of $\gtrsim 10$ keV. The inelastic neutron excitation of states in ^{46}Ti (889 keV), ^{47}Ti (160 keV) and ^{48}Ti (984 keV) was observed. The energy-averaged behavior of the measured results was described in terms of spherical and ellipsoidal optical models and compound-nucleus and direct-reaction processes. The observed fluctuating cross sections were compared with the results of statistical R-matrix calculations based upon the energy-average model parameters and known resonance statistics. It was shown that both compound-nucleus and direct-reaction processes contribute to the fluctuating cross sections and that comparison of calculated and observed fluctuations gave an improved definition of the energy-average models. Furthermore the statistical R-matrix calculations displayed an intermediate resonance structure consistent with experimental observation without recourse to additional reaction mechanisms. The experimental results and their interpretations were used to improve the ENDF/B evaluated nuclear data file. (auth)

17189 (ORNL-4806) NATURAL CHROMIUM AND ^{52}Cr NEUTRON ELASTIC AND INELASTIC SCATTERING CROSS SECTIONS FROM 4.07 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 45p. (ENDF-198). Dep. NTIS $5.45.

Measured neutron elastic and inelastic scattering cross sections for natural chromium between 4.07 and 8.56 MeV and for ^{52}Cr between 6.44 and 8.56 MeV are presented and compared with the elastic differential cross sections of Holmqvist and Wiedling and with ENDF/B MAT 1121. The elastic scattering differential cross sections are in fair agreement with those of Holmqvist and Wiedling. The angle-integrated differential elastic scattering cross sections are systematically higher by as much as 17% than those of Holmqvist and Wiedling above 4.6 MeV, a situation similar to that found in comparing the two sets of data for other elements. The ENDF/B III MAT 1121 elastic angular distributions are found to be in poor agreement with experimental results from 4 to 8.5 MeV, though the ENDF/B III MAT 1121 angle-integrated differential elastic scattering cross sections agree within experimental uncertainties with the results over this energy range. An evaporation model of inelastic scattering is found to be of questionable validity if applied to levels in the residual nucleus of excitation energy less than 6 MeV. (auth)

17190 (ORNL-4807) NATURAL NICKEL AND ^{60}Ni NEUTRON ELASTIC AND INELASTIC SCATTERING CROSS SECTIONS FROM 4.07 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 39p. (ENDF-198). Dep. NTIS $4.00.

Measured neutron elastic and inelastic scattering cross sections for natural nickel between 4.07 and 8.56 MeV are presented and compared with the elastic differential cross sections of Holmqvist and Wiedling and with ENDF/B III MAT 1123. The elastic differential cross sections are in general agreement with those of Holmqvist and Wiedling but our angle-integrated differential elastic cross sections are systematically higher by about 10% than those of Holmqvist and Wiedling above 4.6 MeV, a situation found in comparing the two sets of data for other elements. The ENDF/B III MAT 1123 elastic angular distributions are found to be in poor agreement with experimental results from 4 to 8.5 MeV, though the ENDF/B III MAT 1123 angle-integrated differential elastic cross sections agree generally within experimental uncertainties with our results over this energy range. Additional measurements of ^{60}Ni neutron elastic and inelastic scattering cross sections at 4.34 and 4.92 MeV are given and compared with previous results from 6 to 8.5 MeV and with natural nickel results. Agreement is shown to be excellent. Inelastic scattering cross sections to the 1.450 MeV level in ^{58}Ni are computed from the natural nickel and ^{60}Ni data. An evaporation model of inelastic scattering to levels of excitation energy in the residual nucleus below 6 MeV is found to be of questionable validity. (auth)

17191 OPTICAL MODEL CALCULATION FOR NEUTRON CAPTURE IN THE MASS REGION A = 40–70. Barrett, R. F. (Melbourne Univ., Parkville, Australia). Z. Phys.; 265: No. 1, 55–63(Oct 1973).

Calculations of the s-, p- and d-wave neutron strength functions based on the spherical optical model have been performed for the mass region A = 40–70. The aim was to investigate the radiative neutron capture observed in this region leading to final states with spin $J = 1/2^-$ and $J = 1/2^-$. Results of the calculation indicate that d-wave neutron capture followed by E1 radiative decay is the most likely explanation of the process. (auth)

17192 STUDY OF THE LEVELS OF ^{96}Mo AND ^{53}Mn VIA GAMMA-RAY SPECTROSCOPY. Robertson, C. S. Jr. Lexington, KY; Univ. of Kentucky (1973). 60p. University Microfilms Order No. 73-29,907.

Thesis (Ph. D.).

Levels of nuclei in two major proton shells, the $1g_{9/2}$ and $1f_{5/2}$ shells, and neutron inelastic scattering cross sections in the important mass 90 region were studied. Incident neutrons were used to probe ^{96}Mo, and the ^{53}Cr(p,nγ)^{53}Mn reactions were used to study ^{53}Mn. The ^{96}Mo(n,n'γ) reactions were studied using the pulsed-beam time-of-flight method and Ge(Li) detectors. Excitation functions of the ^{96}Mo transitions were measured, excited by incident neutron energies from 1.1 to 2.8 MeV. These data resulted in the discovery of a new level at 2501.3 keV, and the confirmation of levels at 1147.5, 2095.4, and 2540.0 keV. In addition, neutron inelastic scattering differential cross sections were obtained for incident neutron energies between 1.4 and 2.8 MeV. Angular distribution data taken at incident neutron energies of 1.8 and 2.8 MeV were analyzed in the Wolfenstein-Hauser-Feshbach (WHF) formalism and resulted in definite spin assignments to four levels. Branching ratios and neutron inelastic scattering cross sections were obtained, and gamma-ray mixing ratios and anisotropies were measured. Energy calibration runs were taken, utilizing accurately known transition energies in V, Fe, Mg, and Si. From these data, transition energies were measured to within ±0.5 keV for most gamma rays observed. The results of this experiment are in good agreement with the results of other workers, with few exceptions. The following excitation energies (keV) and spin assignments were obtained from the present data and the results of other experiments: 777.9, 2; 1147.5, 0; 1497.5, 2; 1625.4, 2; 1628, 4; 1869.4, 4; 1978.3, 3; 2095.4, 2; 2219.0, 4; 2234.0, 3; 2425.6, 2 or 3; 2438.4, 5; 2480.2, 2 or 3; 2501.3, 1; 2540.0, 2 or 3; 2594.4, 3; 2622.9, (3 or 4); 2699.6; 2735.4, (3 or 4). Tentative assignments are in parentheses. Angular distributions of γ rays from the ^{53}Cr(p,nγ)^{53}Mn reactions were measured and analyzed in the WHF formalism, resulting in definite spin assignments to three levels. The γ-ray branching ratios were obtained, and γ-ray anisotropies were measured. Excitation energies were determined to within ±2 keV for levels through 3248 keV excitation energy. The energies (keV) of levels studied and the corresponding spin assignments from this and other work are as follows: 2272, $5/2$ or $7/2$; 2571, $(7/2)$; 2685, $7/2$; 2949, $9/2$; 3004, ($3/2$ or $5/2$); 3199, $5/2$, $7/2$ or $9/2$; 3248, ($9/2$). (Diss. Abstr. Int., B)

17193 PHENOMENOLOGICAL THREE-BODY FORCES IN THE $f_{7/2}$ SHELL. Eisenstein, I.; Kirson, M. W. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett., 47B: No. 4, 315-318(26 Nov 1973).

A phenomenological shell-model fit to energy levels of $f_{7/2}$-shell nuclei is performed using both two-body and three-body effective forces as free parameters. The inclusion of the three-body force produces considerable improvements in the fit. (auth)

17194 INELASTIC SCATTERING OF NEUTRONS ON ISOTOPES OF Ti AND Fe IN THE ENERGY REGION NEAR THE THRESHOLD. Konobeevskii, E. S.; Musaelyan, R. M.; Popov, V. I.; Prokopenko, V. M.; Surkova, I. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1764-1767(Aug 1973). (In Russian).

The energy dependence of the cross section near the threshold for the excitation of the first 2^+ level of ^{46,48}Ti and ^{56}Fe during inelastic scattering of neutrons was investigated in the energy interval from 300 to 500 keV over the threshold for the level excitation. (tr-auth)

17195 γ RADIATION FROM THE ^{53}Cr(p,n)^{53}Mn REACTION. Aleksandrov, Yu. A.; Aprelev, M. V.; Antropov, A. E.; Zarubin, P. P.; Orlov, B. N.; Sergienko, V. A. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1702-1704(Aug 1973). (In Russian).

The de-excitation scheme of excited states of ^{53}Mn obtained during bombardment of ^{53}Cr targets with protons at 6 MeV was investigated. (tr-auth)

17196 HIGH RESOLUTION STUDY OF THE ^{40}Ca(^{16}O,^{12}C)^{44}Ti REACTION. Erskine, J. R. (Argonne National Lab., IL); Henning, W.; Greenwood, L. R. Phys. Lett., 47B: No. 4, 335-338 (26 Nov 1973).

High resolution measurements of the α-particle transfer reaction $^{40}Ca(^{12}O,^{12}C)^{44}Ti$ were performed utilizing a split-pole magnetic spectrograph. Comparison with $^{40}Ca(^{6}Li,d)^{44}Ti$ data reveals close agreement for the relative selectivity of final states in the two transfer reactions. No evidence is found for α-particle breakup of ^{16}O or population of the 4.43 MeV first excited state of ^{12}C. (auth)

17197 HIGHER ORDER CORE POLARIZATION CONTRIBUTIONS TO THE EFFECTIVE INTERACTION IN $^{42}Ca-^{42}Sc$. Jopko, A. M.; Sprung, D. W. L. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 21, 2275-2282(1 Nov 1973).

A numerical calculation of the core polarization of the effective interaction between nucleons outside the ^{40}Ca closed shell was carried out, taking account of several higher order processes suggested by Kirson. These are a systematic inclusion of particle-hole scattering, self-screening of phonons, and modification of the one-particle to two-particle, one-hole vertex. These processes have the same effect as in the earlier calculation for ^{16}O; namely, the final result is a very small net core polarization contribution to the effective interaction, which cannot explain the low-lying spectra. (auth)

17198 EXCITED STATES IN ^{53}Mn BY THE $^{53}Cr(p,n\gamma)^{53}Mn$ REACTION. Chung, W. H.; Sheppard, D. M.; Olsen, W. C.; Robertson, B. C. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 17, 1840-1849(1 Sep 1973).

The properties of the low-lying excited states in ^{53}Mn were studied by measuring γ-ray angular distributions and lifetimes using the $^{53}Cr(p,n\gamma)^{53}Mn$ reaction. Energy levels of ^{53}Mn were found at 0.378, 1.288, 1.440, 1.619, 2.272, 2.405, 2.572, 2.670, 2.687, 2.705, 2.872, 2.876, 2.914, 2.947, 3.005, 3.095, 3.125, 3.183, 3.193, and 3.250 MeV. The measurement of γ-ray angular distributions and yield curves together with predictions based on the compound nuclear statistical model have enabled spin assignments to be made to the following excited states in ^{53}Mn: 1.440 MeV ($\frac{1}{2}$), 1.619 MeV ($\frac{7}{2}$), 2.572 MeV ($\frac{5}{2}$), 2.687 MeV ($\frac{5}{2}$), 2.947 MeV ($\frac{7}{2}$), 3.005 MeV ($\frac{5}{2}$). Multipole mixing ratios and branching ratios were determined for some of the observed transitions. Lifetimes of nine excited states in ^{53}Mn were measured using the Doppler-shift attenuation method. (auth)

17199 T = 1 TO T = 0 SPLITTING OF THE $f_{\frac{1}{2}}d_{\frac{5}{2}}^{-1}$ PARTICLE-HOLE MULTIPLET. Osnes, E. (Univ. of Oslo); Kuo, T. T. S. Phys. Lett.; 47B: No. 5, 430-432(10 Dec 1973).

The T = 1 to T = 0 splitting of the $f_{\frac{1}{2}}d_{\frac{5}{2}}^{-1}$ particle-hole multiplet shows a J-dependence which is well reproduced by the Kuo-Brown interaction. The calculated average magnitude of the splitting is too small by a factor of two using the bare particle-hole interaction, but is increased to 80% of the experimental value including the second-order corrections. Results are also given for selected phenomenological and empirical interactions. (auth)

17200 VELOCITY DEPENDENCE OF LOW RECOIL VELOCITY DOPPLER SHIFT ATTENUATION MEASUREMENTS. Robertson, B. C.; Leslie, J. R. (Queen's Univ., Kingston, Ont.). Nucl. Instrum. Methods; 114: No. 2, 389-391(1974).

Doppler-shift attenuation factors for ^{55}Fe levels at 1918, 2052, and 2144 keV excitation were measured for initial recoil velocities between 4.5 and 5.5×10^7 cm/s. The results were compared with both Monte Carlo and Blaugrund calculations and with previous results for higher initial recoil velocity. Good agreement was found for the results at all velocities. The Blaugrund calculations were also found to give close agreement with the more detailed Monte Carlo calculations. (2 figures) (auth)

17201 ELASTIC SCATTERING OF 15 MEV DEUTERONS. Irshad, M.; Robson, B. A. (Univ. of Birmingham, Eng.). Nucl. Phys.; A218: No. 3, 504-508(1974).

Differential cross sections and vector and tensor analyzing powers of 15-MeV deuterons elastically scattered by ^{52}Cr, ^{96}Zr and ^{122}Sn were analyzed in terms of an optical potential containing a tensor term T_R. Neglecting any tensor interactions the differential cross section and vector analyzing power data were well reproduced but only qualitative agreement was obtained with the corresponding tensor analyzing power measurements. The inclusion of a T_R potential only slightly improved the fits to the tensor data. The quantity T_{21} was found to impose greater restrictions than T_{20} and T_{22} on the parameters of the T_R potential. It appears that the conventional optical model has some difficulty in providing an overall description of the data. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

17202 (CONF-730134-, pp vp Paper 13) ISOSPIN EFFECTS AND PRE-EQUILIBRIUM EMISSION. Kalbach-Cline, C. (Univ. of Rochester, NY). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

A lecture is given on a historical approach to isospin effects and pre-equilibrium emission. A review is given of the experimental evidence for isospin in statistical reactions and in pre-equilibrium reactions. The way in which isospin was introduced into the extended Griffin model for pre-equilibrium processes, the predictions of the isospin-dependent model, and the problems and inconsistencies which appear are discussed. (JFP)

17203 (CONF-730134-, pp vp Paper 14) ALPHA IN THE ENTRANCE OR EXIT CHANNEL FROM A PRE-EQUILIBRIUM POINT OF VIEW. Chevarier, N. (Univ., Lyon); Chevarier, A.; Demeyer, A.; Hollinger, G.; Pertosa, P.; Tran Minh Duc.; Alevra, A.; Magda, T. 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The hybrid model with its geometry dependent form using the partial cross section is used as the formalism. It is assumed that four nucleons (2p + 2n) have a good integral overlap with an alpha-like configuration and fermion heredity. The model was tested for alpha particles in the entrance channel and then in the exit channel, including the (α,α′) special case. (JFP)

17204 (COO-2174-15, pp vp 4p) CROSS SECTION RESONANCE PARAMETERS AND RESONANCE ISOTOPE ASSIGNMENTS FOR COPPER TO 31 keV (ANALYSIS BY F. RAHN, W. MAKOFSKE). Jun 1973.

In neutron velocity spectroscopy using the Nevis synchrocyclotron.

17205 (ORO-2972-245) [RESEARCH IN NUCLEAR PHYSICS]. Annual Report, December 1972-November 1973. (Texas Univ., Austin (USA). Center for Nuclear Studies). [nd]. Contract AT(40-1)-2972. 272p. Dep. NTIS $15.75.

The report is divided principally into two parts, dealing with experimental and theoretical research. Most of the theoretical work is devoted to theoretical nuclear physics; the experimental research, on the other hand, falls into the categories of experimental nuclear physics, atomic physics, nuclear astrophysics, and research instrumentation. In addition to reports on completed work and research in progress, abstracts of talks and papers submitted for publication and title pages of published papers are included. A directory of computer programs and lists of publications, abstracts, invited lectures, degrees awarded, and laboratory personnel are also presented. (RWR)

For title listing of a selected paper see: 17206.

17206 (ORO-2972-245, pp 67-75) STUDY OF ^{84}Kr AND ^{86}Kr FROM 12.0-MeV INELASTIC PROTON SCATTERING. Arora, B. K.; Olsen, D. K.; Newson, C.; Chao, J.; Riley, P. J. [nd].

In [Research in nuclear physics]. Annual report, December 1972-November 1973.

17207 NEW DIAGRAM LINES IN THE β-REGION OF THE L SPECTRUM OF HOLMIUM 67. Nigam, A. N.; Kapoor, Q. S. (Rajasthan Univ., Jaipur, India). J. Phys., B (London); 6: No. 11, 2464-2467(Nov 1973).

Employing a 40 cm curved mica crystal spectrograph of the transmission type, the β-region of the L emission spectrum of holmium 67 was investigated. Two new quadrupole lines at λ = 1601.2 and 1593.7 (xu) corresponding respectively to the transitions L_2N_7 and L_3N_7 were reported for the first time. Wavelength data of different workers on the already reported lines in this region were given for the sake of comparison. (auth)

17208 $^{64}Zn(\gamma,n)^{63}Zn$ CROSS SECTION FROM 20.4 TO 21.9 MeV. Del Blanco, W.; Kundu, S.; Boucher, P. (Univ. of Montreal). Can. J. Phys.; 51: No. 12, 1302-1304(15 Jun 1973).

The $^{64}Zn(\gamma,n)^{63}Zn$ cross section was measured over the energy range E_γ = 20.43 to E_γ = 21.94 MeV using monochromatic γ rays from the $T(p,\gamma)^4He$ reaction and detecting the resulting position activity. The γ rays were monitored by a 23 cm diameter by 23 cm long NaI crystal. The positron activity was determined by a coincidence detector consisting of two 7.6 cm diameter by 7.6 cm long NaI crystals set on the annihilation radiation photopeaks. The γ-ray energy resolution was better than 110 keV over the whole energy range. Structure, although reported by other experimenters, was not observed. (auth)

17209 NUCLEAR EXCITATION BY γ RAYS OF RADIOACTIVE SOURCES. Veres, A.; Pavlicsek, I.; Csueroes, M.; Lakosi, L. (Inst. of Isotopes, Budapest). Acta Phys. Acad. Sci. Hung.; 34: No. 1, 97-104(1973).

Nuclear isomers of stable nuclei were excited by inelastic resonance scattering of Compton-scattered γ rays from high-activity ^{46}Sc, ^{60}Co, ^{42}Pr and ^{24}Na radioactive sources. By counting isomeric transition rates, activation cross sections for thirty-five isomers were determined, some of them not previously published. Values

of these cross sections lie between 0.003 and 214 μbarn. The partial level widths $\mu = g\,\Gamma_0\Gamma_i\Gamma^{-1}$ for the transitions leading from the activation to the metastable levels, estimated for twelve activation levels belonging to eight nuclei, are between $4 \cdot 10^{-6}$ and $2 \cdot 10^{-4}$ eV. (auth)

17210 ACCURATE DETERMINATION OF THE $P_k\omega_k$ VALUE AND THE FLUORESCENCE YIELD ω_k OF Sr AFTER ELECTRON CAPTURE DECAY OF ^{88}Y. Bambynek, W.; Reher, D. (Central Bureau for Nuclear Measurements, Geel, Belgium). Z. Phys.; 264: No. 3, 253-258(1973).

The $P_k\omega_k$ value of Sr following ^{88}Y decay has been determined to be $P_k\omega_k = 0.613 \pm 0.004$ using two independent methods for the measurement of the K x-ray emission rate and a calibrated γ-ray spectrometer for the determination of the disintegration rate. With this result and a K-capture probability $P_k = 0.877 \pm 0.003$ deduced from literature the K-shell fluorescence yield of Sr is $\omega_k = 0.699 \pm 0.007$. (auth)

17211 γ-RAY DECAY PROPERTIES OF LOW-LYING LEVELS OF ^{65}Zn VIA THE ^{65}Cu(p,nγ)^{65}Zn REACTION. Ezell, R. L.; Scott, H. L. (Univ. of Georgia, Athens). Nucl. Phys.; A218: No. 3, 470-494(1974).

The γ-ray decay of 13 low-lying levels of ^{65}Zn was studied utilizing the ^{65}Cu(p, nγ)^{65}Zn reaction. The decay scheme was obtained from $\theta_\gamma = 90°$ yield curve measurements and from a neutron-gamma coincidence measurement. Angular distributions of γ-rays were measured for seven angles at $E_p = 3.5$ and 4.0 MeV. Gamma-ray energies, level energies, and branching ratios obtained are compared with recent measurements. Expected angular correlations for possible spin sequences are calculated utilizing Hauser-Feshbach statistical reaction theory. The results, combined with other available evidence, establish the J^π assignments for the following levels: 768.9 ± 0.1 keV ($\frac{5}{2}^-$), 864.8 ± 0.2 ($\frac{1}{2}^-$), 1047.5 ± 0.1 ($\frac{1}{2}^-$), 1252.9 ± 0.4 ($\frac{1}{2}^-$), 1263.9 ± 0.6 ($\frac{3}{2}^-$), and 1343.9 ± 0.1 ($\frac{5}{2}^-$). Previous assignments are confirmed for the levels 909.8 ± 0.1 keV ($\frac{3}{2}^-$) and 1369.5 ± 0.2 ($\frac{5}{2}^+$). Limiting J-values are obtained for the levels of 1577.1 ± 0.2 keV ($\leq\frac{1}{2}$) and 1588.2 ± 0.4 ($\leq\frac{1}{2}$). Gamma-ray multipole mixing ratios are extracted for 19 transitions between low-lying levels and transition strengths calculated where the level lifetimes are assumed to be in the range 10^{-12} to 10^{-13} sec. (auth)

17212 EXCITATION OF $T_>$ COMPONENTS OF THE GIANT DIPOLE STATES IN N > Z NUCLEI BY MUON CAPTURE. Nalcioglu, O. (Univ. of Rochester, NY); Rowe, D. J.; Ngo-Trong, C. Nucl. Phys.; A218: No. 3, 495-503(1974).

Muon capture on N > Z nuclei is proposed as a means of studying the $T_>$ isospin component of giant dipole states. Calculations for nickel isotopes (except ^{56}Ni) indicate that these states are strongly excited by muon capture. Possible experiments to detect these states are discussed. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 15345, 15708, 17102, 17136, 17150, 17173, 17179, 17192, 17201–17203, 17209, 17267, 17276, 17309, and 17320.

17213 (AE-265) DECAY PROPERTIES OF ^{147}Nd. Backlin, A.; Malmskog, S. G. (Aktiebolaget Atomenergi, Stockholm (Sweden)). 1967. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Electron and gamma transition energies and intensities in the decay of ^{147}Nd were studied using a double focussing beta spectrometer and a Ge(Li)-detector. From the deduced multipolarities of the transitions to all levels in ^{147}Pm are found to have positive parity in contrast to the fact that the neighboring nucleus ^{149}Pm was found to have several low lying negative parity states. (auth)

17214 (AECL-4601) NUCLEAR PHYSICS WITH A HIGH FLUX NEUTRON FACILITY. Bartholomew, G. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50

Progress in nuclear physics with neutrons is reviewed, with particular attention to trends since the Santa Fe Seminar on Intense Neutron Sources, 1966. Areas of physics and techniques showing special promise for future studies are discussed. Particular attention is directed to the fundamental properties of the neutron, fission, polarization measurements and scattering with fast neutrons, gamma resonance fluorescence (with beams derived from the (n,γ) reaction), and γ-ray strength functions. (9 figures, 6 tables) (RWR)

17215 (AECL-4604) MIRROR NUCLEI, A LESS THAN OR EQUAL TO 100. Hardy, J. C. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1973. 31p. (CONF-730673-1). Dep. NTIS (U. S. Sales Only) $3.75.

From Canadian Association of Physicists meeting; Montreal, Canada (18 Jun 1973).

The effects of charge-dependent forces are described, and their dependence on the nuclear mass is discussed. It is proposed that large isospin impurities may occur in heavier nuclei (A ≤ 100) with N ~ Z. Several classes of β-decay experiment are sensitive to these effects, and a detailed description is given of recent Chalk River experiments to study the super-allowed decay of 0^+, $T_z = -1$ nuclei. The first measurement of mirror Fermi decay branches within a T = 1 multiplet is discussed. These and other data on superallowed β-decay are analyzed with particular emphasis on the charge dependent corrections to which mirror comparisons are particularly sensitive. The results are discussed in terms of the theory of weak interactions and the question of the existence of a heavy intermediate vector boson. It is suggested that some discrepancies for nuclei with A > 40 may be attributed to the proposed increase in charge dependent mixing. Some other experimental evidence suggesting the same conclusion is also given. (auth)

17216 (CONF-730134-) XI INTERNATIONAL WINTER MEETING ON NUCLEAR PHYSICS, VILLARS, SWITZERLAND, JANUARY 22–27, 1973. (Milan Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Milan (Italy)). 1973. 562p.

The conference included 38 papers, five of which were abstracted previously in NSA. For abstracts of these papers see abstract numbers: 27:13630 and 29166 and 28:14024, 23042, and 27425. Separate abstracts were prepared for 33 papers. (JFP)

For abstracts of individual papers see: 17132–17137, 17174–17176, 17202, 17203, 17217, 17218, 17276, 17289–17297, and 17316–17325.

17217 (CONF-730134-, pp vp Paper 12) EMISSION BY PRE-EQUILIBRIUM EFFECT IN (n,α) AND (p,α) REACTIONS ON MEDIUM AND HEAVY NUCLEI. Braga-Marcazzan, M. G.; Milazzo-Colli, L. (CISE, Milan). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Particle emission by the pre-equilibrium mechanism was studied for (n,α) and (p,α) reactions with A > 90 nuclei. The alpha spectra and cross sections are found. (JFP)

For title listings of selected sections see: 17177, 17204, 17220, and 17253.

17218 (CONF-730134-, pp vp Paper 33) CONSTRAINED HARTREE–FOCK CALCULATIONS OF DEFORMATION NUCLEAR PROPERTIES. Flocard, H. (Institut de Physique Nucleaire, Orsay, France). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Constrained Hartree–Fock calculations were performed with the Skyrme interaction in order to describe the deformation properties of all the nuclei of the mass table. Since the predictions agree rather well with the experimental results for some typical nuclei spread over the whole mass table, it is believed that the method gives a reliable way to estimate deformation properties of other nuclei. (JFP)

17219 (COO-2174-15) NEUTRON VELOCITY SPECTROSCOPY USING THE NEVIS SYNCHROCYCLOTRON. Progress Report, July 30, 1972–June 30, 1973. Rainwater, J. (Columbia Univ., New York (USA). Dept. of Physics). Jun 1973. Contract AT(11-1)-2174. 150p. Dep. NTIS $9.50.

The period August 1, 1972, to June 30, 1973, was marked by the continuing of the analysis of the vast amounts of data obtained during 1968 and 1970 pulsed-neutron time-of-flight spectroscopy runs using the Nevis Synchrocyclotron. Many major research papers from that period have now appeared in print. The numerous evolving results for even A nuclei having atomic mass 150 < A < 190 have given first conclusive (and growing) confirmation of Dyson's theories concerning level spacing systematics. Monte Carlo studies leading to a better understanding of the implications of these theories have also been published. The important paper on ^{238}U and ^{232}Th is now published, as is that for the Yb isotopes. Papers on the W isotopes, on Na, and on K have been submitted for publication. Results for the Gd and Sm isotopes, for the Cd isotopes, for Ta, for argon, for calcium, for sodium, for potassium, for copper (^{63}Cu and ^{65}Cu), and for chlorine are contained in the full report COO-2174-15. (auth)

17220 (COO-2174-15, pp vp 57p) PRELIMINARY DISCUSSION OF RESONANCE PARAMETER RESULTS SINCE AUGUST 1972 FOR THE SEPARATED ISOTOPES OF Cd (ANALYSIS MAINLY BY DR. H. I. LIOU). Jun 1973.

In neutron velocity spectroscopy using the Nevis synchrocyclotron.

17221 STUDY OF LEVELS IN ^{149}Nd USING THE (d,t) AND (^{3}He,α) REACTIONS. Burke, D. G.; Waddington, J. C.; Nelson, D. E.; Buckley, J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 4, 455-464(15 Feb 1973).

Triton spectra from the ^{150}Nd(d,t)^{149}Nd reaction were measured at 15 angles using beams of 12-MeV deuterons. The ^{150}Nd(^{3}He,α)^{149}Nd reaction was studied at four angles with 24 MeV ^{3}He beams. In all cases the reaction products were analyzed with an Enge-type magnetic spectrograph and detected with photographic emulsions. The peak widths (FWHM) were approximately 8 keV for the (d,t) studies and 25 keV for the (^{3}He,α) spectra. It is now evident that the highest energy triton group ascribed to the ^{150}Nd(d,t)^{149}Nd reaction in previous works does not correspond to the ground state transition. According to the current interpretation the ground state transition has a Q value of -1.122 ± 0.010 MeV. The (d,t) angular distributions and the ratios of (^{3}He,α) and (d,t) cross sections at selected angles were used to determine l values for a number of the transitions. Three states in ^{149}Nd at 481, 813, and 986 keV are definitely populated by l = 0 transitions and thus have $I^\pi = 1/2^+$. A strongly perturbed band consisting of a mixture of Nilsson states from the i_{13} shell was found, with properties similar to the corresponding bands in the isotones ^{151}Sm and ^{153}Gd. The total observed intensity for each of the l values 0, 1, 2, and 6 cannot be explained by the extreme single-particle shell model but is consistent with that predicted by the Nilsson model. However, the splitting of the strength among the observed states cannot be explained by the basic Nilsson model. (auth)

17222 TOTAL GAMMA-RAY CROSS SECTIONS IN Cd. Rao, K. S.; Prasad, G. A.; Rao, P. V. R.; Parthasaradhi, K. (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys.; 11: No. 5, 364(May 1973).

Total gamma ray cross sections in Cd are measured in the energy region 60 to 1330 keV. These values are compared with the recently compiled theoretical data [Storm, E. & Isreal, H. J., Nucl. Data, 7(1970), 505]. It is found that the agreement is within 5%. (auth)

17223 PENETRATION PARAMETER FOR M1 CONVERSION AND E2 ADMIXTURE FOR 81-keV TRANSITION IN ^{133}Cs. Ramaniah, K. V.; Rao, B. M.; Reddy, K. V. (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys.; 11: No. 5, 363-364 (May 1973).

The penetration parameter (λ), the percentage E_2 admixture (δ^2) and the retardation factor [$R(M_1)$] for the 81-keV transition in ^{133}Cs are obtained using the experimental L-subshell intensity ratios and the theoretical tables for conversion coefficients and penetration functions of R. Hager and E. Seltzer [Nucl. Data, A4 (1968), 235]. The calculated results are: $\lambda(81) = -4.5^{+2.2}_{-2.2}$; $\delta^2 = 0.028^{+0.2071}_{-0.0025}$ and $R(M_1) \approx 430$. (auth)

17224 FAST NEUTRON SCATTERING AT 180° FROM Pb AND Sn. Gupta, M. C.; Tripard, G. E. (Washington State Univ., Pullman). Can. J. Phys.; 51: No. 2, 121-124(15 Jan 1973).

A measurement of the differential scattering of 3.65-MeV neutrons from the D(d,n)^{3}He reaction at the angles 10 and 180° by Pb and Sn was made. The results at 180° were anomalously high compared with optical model predictions. An experimental arrangement using the associated particle technique and large thin film $(CD_2)_x$ targets is described which has made measurements of the differential scattering of neutrons at the extreme backward angles (~180°) possible. (auth)

17225 ^{149,151}Sm(p,t)^{147,149}Sm REACTIONS. Gadsby, R. D.; Burke, D. G.; Waddington, J. C. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 2, 203-208(15 Jan 1973).

Two-neutron pickup reactions were performed on targets of ^{149}Sm and radioactive ^{151}Sm using 18-MeV protons. The outgoing tritons from the ^{151}Sm target were analyzed with a magnetic spectrograph at 16 angles between 6 and 80°. Unlike the two-neutron transfer data on neighboring even-even targets, the angular distributions indicated l = 0 transitions to many levels in the final nucleus. Partial angular distributions for the ^{149}Sm(p,t)^{147}Sm reaction were obtained, but showed only one strong l = 0 transition populating the ^{147}Sm ground state. In addition, spectra from the ^{152}Sm(p,t) reaction were measured at several angles in order to provide normalization to previous results. (auth)

17226 DECAY OF ^{124}Sb. Johnson, J. R. A. Vancouver, B. C.; University of British Columbia, Vancouver (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The gamma-rays, beta rays and conversion electrons emitted in the beta decay of ^{124}Sb → ^{124}Te were observed using Ge(Li) and Si(Li) detectors both singly and in coincidence. The measured energies and intensities of the different transitions involved in this decay together with the coincidence results have allowed one to construct the decay scheme. The angular momentum of most of the states and the parity of all of the states of ^{124}Te populated in this decay were deduced, some of them for the first time, and others as confirmations of previous assignments. Also collective parameters were assigned to many of these states, in terms of the vibrational model of nuclei, from the reduced branching ratios calculated from the gamma ray intensities. (Diss. Abstr. Int., B)

17227 INELASTIC COLLISIONS BETWEEN DEUTERONS WITH 2.43 GeV/c AND ATOMIC NUCLEI OF PHOTOGRAPHIC EMULSION. Kubicar, L. (Inst. of Physics, Bratislava). Fyz. Cas.; 22: No. 3, 163-169(1972).

Inelastic collisions are discussed between deuterons and atomic nuclei during which a high-speed deuteron is emitted from the nucleus as a secondary particle. The particles are identified in relation to the ionization dependence on $p\beta$. A model of the cascade of interactions of a primary particle and relatively independent static nucleons is used in interpreting the observed collisions of deuterons and atomic nuclei. The absorption cross section makes it possible to evaluate the mean free path of the primary particle inside the nucleus and the probability of single and double interactions in the nucleus. The observed number of secondary deuterons was used in estimating the probability that during a single collision in the cascade inside the nucleus a deuteron had not been disintegrated into its components. (Nuclear Sci. Abstr. Czech.)

17228 REORIENTATION EFFECT IN COULOMB EXCITATION FOR THE NUCLEI ^{108}Pd AND ^{167}Er. Lutz, W. R. Lafayette, IN; Purdue Univ. (1973). 137p. University Microfilms Order No. 73-28,109.

Thesis (Ph. D.).

The quadrupole moment of the 0.434 MeV 2^+ state in ^{108}Pd was measured by detecting the deexcitation γ rays following Coulomb excitation in coincidence with scattered ^{32}S ions. If excitation via the second 2^+ state interferes constructively with the direct excitation of the first 2^+ state, i.e., increasing the excitation probability of the first 2^+ state, $Q_{2+} = -0.51 \pm 0.08$ b. If the interference is destructive, $Q_{2+} = -0.30 \pm 0.08$ b. An attempt to determine the sign of the interference by measuring the energy dependence of the reorientation effect is also discussed. In order to cross-check the reorientation effect as a method of determining nuclear quadrupole moments, the quadrupole moment of the first 2^+ state in the "rotational" nucleus ^{170}Er was measured. A ^{81}Br projectile was used to maximize the magnitude of the reorientation effect while reducing higher state corrections to negligible amounts. The value $Q_{2+} = -1.94 \pm 0.23$ b was found for the 79 keV 2^+ state in ^{170}Er, which is in excellent agreement with the rotational value $|Q_{2+}(\text{Rot})| = 2.15 \pm 0.04$ b. (Diss. Abstr. Int., B)

17229 HALF-LIFE INVESTIGATIONS OF EXCITED LEVELS IN THE NUCLEI ^{133}Cs, ^{130}Xe, ^{59}Co, ^{170}Yb, ^{166}Er, ^{182}W, AND ^{154}Gd. Green, M. I. Detroit; Wayne State Univ. (1973). 240p. University Microfilms Order No. 73-31,725.

Thesis (Ph. D.).

Techniques were developed for the use of single and multichannel continuous-strip electron multipliers as detectors of conversion electrons and beta particles in a fast-slow delayed-coincidence system. A new fast-timing method using Ge(Li) detectors was developed that compensates for the delayed rise time of the pulses from these detectors and also improves the timing resolution for low intensity gamma-ray photopeaks located in the Compton continuum of higher energy gamma rays. Plastic scintillators, single and multichannel continuous-strip electron multipliers, and a Ge(Li) detector were used to measure or put upper limits on the half-lives of excited levels of the following nuclei: ^{133}Cs, 81.0 keV level, 6.4 ± 0.4 nsec; ^{130}Xe, 0.58 keV, 1.207 keV, 1.950 keV, 2.639 keV levels, all <50 psec; ^{59}Co, 1.292 MeV level, 564 ± 20 psec; ^{170}Yb, 84.2 keV level, 1.60 ± 0.02 nsec; ^{166}Er, 80.57 keV level, 2.08 ± 0.10 nsec and 1786.94 keV level, <300 psec; ^{182}W, 100 keV level, 1.55 ± 0.05 nsec, 1289 keV level, 1.07 ± 0.05 nsec, and 1553 keV level, 1.32 ± 0.05 nsec; ^{154}Gd, 123.07 keV level, 1.18 ± 0.05 nsec, 996.29 keV level, <390 psec, 1127.80 keV level, <470 psec, 1397.6 keV level, <410 psec, and 1719.6 keV level, <420 psec. A discussion of the interpretation of some of these measurements with respect to specific nuclear models is presented. (Diss. Abstr. Int., B)

17230 MEASUREMENTS OF THE ^{59}Ni(n,α) CROSS SECTION FOR THERMAL NEUTRONS. Eiland, H. M.; Kirouac, G. J. (Knolls Atomic Power Lab., Schenectady, NY). Nucl. Sci. Eng.; 53: No. 1, 1-8(Jan 1974).

The (n,α) reaction cross section for ^{59}Ni was measured at thermal-neutron energies. The experiment utilized dielectric, alpha-particle track detectors and a known thermal-neutron flux. Twelve measurements were made with nickel samples of different thick-

ness and ^{59}Ni enrichment and with track detectors of varying efficiency. The average of all measurements gave the result $\sigma(n,\alpha)$ (2200 m/sec) = 13.7 ± 1.2 b. (6 figures, 3 tables) (auth)

17231 YIELD DISTRIBUTION OF RADIOACTIVE NUCLIDES PRODUCED BY PHOTOSPALLATION REACTIONS IN ^{133}Cs AND ^{139}La WITH 250 MeV BREMSSTRAHLUNG. Kato, T.; Tsai, H. T. (Tohoku Univ., Sendai). J. Inorg. Nucl. Chem.; 36: No. 1, 1-5 (Jan 1974).

The yields of various radioactive nuclides produced in ^{133}Cs and ^{139}La as a result of the (γ,xnyp) reactions with 250-MeV bremsstrahlung were measured with the aid of radiochemical techniques in order to study the features of the photospallation reactions on nuclei in the heavy mass region. When yields were plotted against the difference in mass between target and product nuclei, it was found that the curves thus obtained showed a similar Gaussian form for any separated element and that the peak yields occurred at about three mass units to the neutron-deficient side of the valley of the beta-stability. The general behavior observed in the yield distributions was quite similar to that associated with spallation reactions with high energy particles in this mass region. (auth)

17232 SYSTEMATICS OF THE INTERFERENCE BETWEEN DIRECT AND INDIRECT MODES IN TWO-NUCLEON PICKUP AND STRIPPING REACTIONS BETWEEN HEAVY IONS. Ascuitto, R. J. (Yale Univ., New Haven); Glendenning, K. Phys. Lett., 47B: No. 4, 332-334(26 Nov 1973).

The interference between direct and indirect modes of excitation of vibrational states in two-nucleon transfer reactions is of opposite sign for stripping as compared to pickup reactions. If the indirect modes are sufficiently strong, destructive interference gives rise to a dip in the angular distribution at the grazing angle, compared to the normal shape when the interference is constructive. The absolute sign of the interference may change through a string of isotopes thus revealing details of the structure of vibrational states not accessible through other experiments. (auth)

17233 γ SPECTRA OF ^{105}Ag. Sergienko, V. A.; Safonov, L. A.; Bernotas, V. I.; Bibichev, A. B. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1666-1670(Aug 1973). (In Russian).

The γ spectrum of ^{105}Ag was investigated. One new transition was detected. The existence of some low-intensity transitions was confirmed. The intensities of the γ rays were made more precise. (JSR)

17234 INTERPRETATION OF SOME MULTIPARTICLE LEVELS EXCITED DURING THE DECAY OF THE ^{117}Sb AND ^{105}Cd ISOMERS. Peker, L. K.; Volmyanskii, E. I.; Gerasimenko, B. F.; Dubro, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1711-1713(Aug 1973). (In Russian).

Analyses and calculations were made to show that some of the levels of ^{117}Sb can be treated as three-quasiparticle levels resulting from the splitting of the multiplet from a configuration of the $\{n(j_1j_2)_{I_{12}}p(j_3)\}$ type under the influence of np interactions. The levels proposed as three-quasiparticle are tabulated. Similar analyses and calculations for ^{105}Cd showed that levels with $J^P = 21/2^+$ can be interpreted as three-quasiparticle levels. (JSR)

17235 FIRST EXCITED STATE OF THE DOUBLY MAGIC NUCLEUS ^{132}Sn, POPULATED BY THE β DECAY OF ^{132}In ($T_{1/2}$ = 0.12 SEC.). Kerek, A.; Holm, G. B.; De Geer, L. E.; Borg, S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1629-1632(Aug 1973). (In Russian).

The high intensity γ lines accompanying the β decay were measured up to energies of 8 MeV. The position of levels were calculated using the small radius δ-force model. The high energy of the first excited level of ^{132}Sn indicates the high rigidity of this nucleus. (JSR)

17236 EXCITED STATES OF ^{130}Sn, OBSERVED DURING THE DECAY OF ^{130}In. Kerek, A.; Holm, G. B.; Borg, S.; Carle, P. (Inst. of Physical Research, Stockholm). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1624-1627(Aug 1973). (In Russian).

The decay scheme of ^{130}In was determined. Some of the excited states of ^{130}Sn and their spins and parities were determined. Some assignments of γ transitions were made. (JSR)

17237 DECAY ^{132}Sb → ^{132}Te WITH $T_{1/2}$ = 3.4 AND 4.9 MIN. Kerek, A.; Carle, P.; Borg, S.; McDonald, J. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1622-1623(Aug 1973). (In Russian).

Two states of ^{132}Sb with half lives of 3.4 and 4.9 min. were detected and their spins and parities were 4^+ and 8^- respectively. Some excited levels of ^{132}Te were detected and their spins and parities determined. (JSR)

17238 INVESTIGATION OF THE DECAY OF NEODYMIUM AND PRASEODYMIUM NUCLIDES WITH MASS NUMBER A = 136. Buttsev, V. S.; Vylov, Ts.; Gromov, K. Ya.; Kalinnikov, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1581-1589(Aug 1973). (In Russian).

The decay of the chain ^{136}Nd → ^{136}Pr → ^{136}Ce was studied. During the decay of ^{136}Nd and ^{136}Pr about 100 new γ transitions were detected and identified. The types of multipolarity were determined for a series of them. The decay scheme of ^{136}Nd (55.0 min) was first proposed and the decay scheme of ^{136}Pr (12.9 + 0.4 min) was significantly augmented. (tr-auth)

17239 β DECAY OF THE 7^- ($T_{1/2}$ = 1.6 min) ISOMERIC AND GROUND STATES OF ^{130}Sn ($T_{1/2}$ = 3.8 min) EXCITED STATES OF ^{130}Sb. Kerek, A.; Carle, P.; Borg, S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1620-1621(Aug 1973). (In Russian).

On the basis of measurements of the γ spectrum, internal conversion electron spectrum, and $\gamma-\gamma$ coincidences of the 0^+ (ground) and 7^- (isomeric) states of ^{130}Sn its decay scheme was formulated and conclusions were drawn on the energy levels of ^{130}Sb. (JSR)

17240 STATES OF THE PROTON-NEUTRON HOLE TYPE IN ^{132}Sb, POPULATED BY THE DECAY OF THE DOUBLY MAGIC NUCLEUS ^{132}Sn. Kerek, A.; Holm, G. B.; Carle, P.; McDonald, J. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1617-1619(Aug 1973). (In Russian).

On the basis of the measurement of the coincidence spectrum, multidimensional γ spectrum, and conversion electrons the level scheme of ^{132}Sb was determined. A comparison was made of the energies of the experimentally observed levels of ^{132}Sb with their calculated positions found in assumptions on interactions of the δ-force type between proton and neutron holes. (JSR)

17241 INVESTIGATION OF THE γ SPECTRUM OF ^{147}Eu. Ageev, V. A.; Kravtsov, V. V.; Maidanyuk, V. K.; Mitrokhovich, N. F.; Strizhak, V. I.; Feoktistov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1695-1696(Aug 1973). (In Russian).

The γ spectrum of ^{147}Eu with $E_\gamma > 100$ keV was investigated using a Ge(Li) spectrometer. The energies and intensities were measured. New lines were observed at 550, 1626, and 1637 keV. New levels of ^{147}Sm at 550 and 1656 keV were introduced. (tr-auth)

17242 γ LINES OF ^{146}Gd AND ^{149}Gd. Ageev, V. A.; Kravtsov, V. V.; Maidanyuk, V. K.; Mitrokhovich, N. F.; Strizhak, V. I.; Feoktistov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1692-1694(Aug 1973). (In Russian).

The γ spectra were measured with a Ge(Li) spectrometer. In ^{146}Gd two new weak lines at 421 and 576 keV were detected. The decay scheme of this isotope is given. In ^{149}Gd new lines were observed at 482.9, 553.1, 601.6, 726.5, and 734.5 keV. (JSR)

17243 COUPLING OF THE COLLECTIVE AND QUASIPARTICLE EXCITATIONS OF EVEN-EVEN SPHERICAL NUCLEI. Vdovin, A. I.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1750-1760(Aug 1973). (In Russian).

Within the framework of the two-body + multipole-multipole force model using the quasiboson approximation the effect of the relation of the two-quasiparticle and phonon excitation of the structure of a series of 4^+ and 5^- states of even-even semimagic nuclei was investigated. The energies, wave functions, and $B(E2, 4^+ \rightarrow 2_1^+)$ magnitudes for these states were calculated for a series of isotopes of Sn and isotopes with N = 82 and 50. (tr-auth)

17244 DOPPLER-SHIFT ATTENUATION OF THE ENERGY OF γ RAYS EMITTED AS A RESULT OF COULOMB EXCITATION. Erokhina, K. I.; Lemberg, I. Kh.; Pasternak, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1595-1608(Aug 1973). (In Russian).

Expressions were obtained for the theoretical forms of the Doppler shift of γ lines for recoil nuclei. These expressions were used for carrying out a series of systematic calculations on the effect of different parameters on the forms of these lines and on the errors of the lifetimes determined as a result of the comparison of experimental and theoretical forms of the γ lines. (JSR)

17245 LIFETIMES OF EXCITED STATES OF ^{99}Ru AND ^{100}Ru NUCLEI. Begzhanov, R. B.; Gladyshev, D. A.; Azimov, K. Sh.; Narzikulov, M.; Teshabaev, K. T. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 82-85(1973). (In Russian).

By means of the fast-slow coincidence installation the lifetimes of the excited states at 89, 442, 617, and 897 keV of ^{99}Ru and at 127, 307, 311, and 545 keV of ^{101}Ru were measured. These levels were excited from the decay of ^{99}Rh, ^{101}Rh, and ^{101}Tc. On the basis of the results obtained experimental values were calculated for the probability of some γ transitions. (tr-auth)

17246 PERTURBED ANGULAR CORRELATION MEASUREMENT OF THE G-FACTOR OF THE 668 keV STATE IN ^{132}Xe.

de Waard, H.; Kaufmann, E. N.; Rodgers, J. W. (Bell Telephone Labs., Inc., Murray Hill, NJ). Z. Phys.; 265: No. 5, 423-426 (1973).

A value $g = 0.38 \pm 0.06$ was obtained for the g-factor of the 668 keV state of ^{132}Xe ($\tau = 7.3 \pm 0.6$ psec) from time-integral perturbed angular correlation measurements on gamma cascades in ^{132}Xe. Sources of ^{132}Te implanted in iron were used to obtain a magnetic hyperfine field of 1,510 ± 100 kG at the ^{132}Xe nuclei. (auth)

17247 INVESTIGATION OF THE $0^- \rightarrow 0^+$ and $0^- \rightarrow 2^+$ BETA TRANSITIONS IN THE DECAY OF ^{144}Pr. Bosch, H. E.; Behar, M.; Cambiaggio, M. C.; Garcia Bermudez, G.; Szybisz, L. (Univ., Buenos Aires). Can. J. Phys.; 51: No. 21, 2260-2269(1 Nov 1973).

The first-forbidden beta transitions $0^- \rightarrow 0^+$ and $0^- \rightarrow 2^+$ from the decay of ^{144}Pr were studied. The corresponding spectrum shape factors and end-point energies were determined by means of a simultaneous fit of the data on both beta spectra with a theoretical function. The contribution of the induced pseudoscalar term was investigated analyzing the available information on spectrum shape factors, angular correlation, and longitudinal polarization. The data corresponding to both transitions were handled simultaneously. The introduction of the induced pseudoscalar term is not indispensable for the interpretation of the experimental data. Besides, the nuclear matrix element $f = \langle Y_0 \sigma \cdot p \rangle / M \langle r T_{01} \rangle$ for the $0^- \rightarrow 0^+$ transition was determined. (auth)

17248 ANALYSIS OF CLAIMS AND AVAILABLE RADIOACTIVE DATA FOR SAFEGUARDS. Berenyi, D. (Inst. of Nuclear Research, Debrecen, Hungary). pp 269-283 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.1); CONF-730302-(Vol.1).

On the occasion of the First Meeting of the International Working Group on Nuclear Structure and Reaction Data at the IAEA, a number of requests and priority lists were presented from the different application fields of nuclear data. Of these, one of the relatively most detailed and concrete ones was the list of non-neutron nuclear data needs for safeguards development purposes, which was published during the year in a more concise and modified form, as an IAEA Report. On the basis of the above lists, a comparison of the requested and available data was carried out. The most strongly expressed claims are for the half-lives of ^{95}Zr, ^{106}Ru, ^{134}Cs, ^{137}Cs, ^{140}Ba, and ^{144}Ce, as well as the gamma yield per beta decay for ^{95}Zr, ^{106}Ru, ^{134}Cs, ^{137}Cs, ^{140}La, and ^{144}Ce, with an accuracy of one percent in general. The results of the analysis are given in tables. Conclusions are drawn and some suggestions are given for further experimental tasks, for the use of the facilities of the Oak Ridge Nuclear Data Center (Recent References, Nuclear Data Sheets, tables of selected radioactive isotopes, computerized file of references) and for the request lists. (2 tables) (auth)

17249 NEED OF NUCLEAR LEVEL SCHEMES FOR CALCULATED CROSS-SECTIONS OF FISSION-PRODUCT NUCLEI. Gruppelaar, H. (Reactor Centrum Nederland, Petten). pp 553-558 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.1); CONF-730302-(Vol.1).

For many fission product nuclei, no measurements of fast neutron cross sections are available; for other fission product nuclei, only a few measured points are known. Calculated cross sections are needed, therefore, to provide a set of data with adjustable parameters. Adjustments to cross-section data can be applied by using experimental data of differential measurements from accelerators or by using results of integral experiments like the reactivity worths measured in the Dutch STEK reactor. In the energy range between 0.1 MeV and 3 MeV, which is important for fast-breeder reactors, a good knowledge of excitation energies, spins, and parities of levels in the target nucleus is necessary for the calculation of both the neutron inelastic scattering cross section and the neutron absorption cross section. The need of level-scheme information and the desirability of a compilation and/or evaluation of these data for practical calculations of fission product neutron cross sections are discussed. (1 figure, 2 tables) (auth)

17250 MEASUREMENT AND EVALUATION OF THE ACTIVATION RESONANCE INTEGRAL OF ^{146}Nd, ^{148}Nd, AND ^{150}Nd. Ricabarra, M. D.; Turjanski, R.; Ricabarra, G. H. (Comision Nacional de Energia Atomica, Buenos Aires). Can. J. Phys.; 51: No. 13, 1454-1462(1 Jul 1973).

Values of the ratio of the reduced activation resonance integral to the thermal cross section, I'/σ_0, of ^{146}Nd, ^{148}Nd, and ^{150}Nd were determined relative to gold by measuring cadmium ratios. A lithium-drifted germanium gamma-ray spectrometer was used to resolve the activities of the irradiated samples. The results are: for ^{146}Nd $I'/\sigma_0 = 1.42 \pm 0.10$ and with an assumed $\sigma_0 = 1.4$ b, $I' = 1.99 \pm 0.20$ b; for ^{148}Nd $I'/\sigma_0 = 4.22 \pm 0.14$ and with an assumed $\sigma_0 = 2.5$ b, $I' = 10.5 \pm 0.9$ b; and for ^{150}Nd $I'/\sigma_0 = 13.7 \pm 0.8$ and with an assumed $\sigma_0 = 1.2$ b, $I' = 16.4 \pm 2.8$ b. The resolved and unresolved epithermal integrals of ^{146}Nd, ^{148}Nd, and ^{150}Nd were calculated. Values of the spectral correction factor were also calculated, so the resonance integral could be obtained from the epithermal integral data measured in the reactor spectrum in this experiment. Epithermal integral and spectral correction factors are listed in the text. The most important result of this investigation is that the ^{148}Nd activation reduced resonance integral is about half of the previously recommended value and consequently the radiative width for ^{149}Nd is also about half of the previously accepted value. (auth)

17251 BUBBLE DENSITY DISTRIBUTIONS ON SPHERICAL NUCLEI. Beiner, M.; Lombard, R. J. (Institut de Physique Nucléaire, Orsay, France). Phys. Lett.; 47B: No. 5, 399-404(10 Dec 1973).

The interpretation of the $^{183,185}Hg$ anomalous isotope shifts based on a sudden occurrence of low-lying states belonging to bubble configurations is shown to be unrealistic. Moreover, using an extension of the energy density formalism in which the single quasi-particle structure of nuclei is taken into account it is found that (a) neither the neutron- nor the proton ground state density of all proposed bubble candidates presents any particular central depletion and (b) for low-lying states bubble configurations cannot compete with usual ones except in the hypothetic cases of spherical nuclei with extremely large proton numbers $Z \gtrsim 200$. (auth)

17252 NUCLEAR DATA SHEETS: RECENT REFERENCES. Nucl. Data Sheets; 11: No. 1, 1-119(Jan 1974).

This publication is a current guide to experimental nuclear physics papers, issued three times per year. The information is described by a key word string, from which the user should be able to tell whether the indexed papers contain results relevant to his interests. Each issue supplements earlier ones, the present volume covering literature received by the Nuclear Data Project or assigned key numbers between May 1 and August 31, 1973. Recent references contains three major sections: key numbers and key words, reaction index, and references. (RWR)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 15725, 15740, 16789, 17093, 17150, 17202, 17203, 17209, 17217, 17221, 17225, 17228, 17229, 17243, 17252, 17304, and 17309.

17253 (COO-2174-15, pp vp 16p) RESULTS FOR $^{160,161,162,163,164}Dy$. Jun 1973.

In neutron velocity spectroscopy using the Nevis synchrocyclotron.

17254 1333.1 AND 1559.4 keV ISOMERS IN ^{176}Hf. Khoo, T. L.; Waddington, J. C.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 2, 153-157(15 Jan 1973).

The half-lives of the 1333.1 and 1559.4 keV isomers in ^{176}Hf were determined to be 9.5 ± 0.2 and 9.8 ± 0.2 μs respectively. The upper isomer feeds the lower by means of a 226.25 ± 0.06 keV (M2) transition and a $53.49 \pm 0.07 - 172.75 \pm 0.04$ keV cascade. The multipolarities of the members of the cascade are E1 and {M1(76 ± 13%) + E2(24 ± 13%)} respectively. Because it is fed from the upper state, the 1333.1 keV state appears to decay with a half-life significantly longer than its true value. The half-life of this state was therefore determined by using a TAC to measure the elapsed time between the detection of a gamma ray feeding the state and one deexciting it. (auth)

17255 LEVELS IN ^{153}Gd AND ^{155}Gd STUDIED WITH THE (p,t) REACTION. Loevhoeiden, G.; Burke, D. G.; Waddington, J. C. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 12, 1369-1376(15 Jun 1973).

States in ^{153}Gd and ^{155}Gd were populated with (p,t) reactions induced by 18 MeV protons. In ^{153}Gd, strong $l = 0$ transitions were found to the $\frac{3}{2}^-[521]$ ground state and the $\frac{3}{2}^-$ β-vibrational state. Excited rotational members of the ground state band and the β-vibrational band were also identified. Strong $l = 0$ transitions were

observed to the ground state, the 129, 509, and 531 keV levels in ^{153}Gd. The population of members of the previously suggested ground state band in ^{153}Gd confirms the earlier $\frac{3}{2}^-$[521] assignment. It is proposed that the 129 keV level is a mixed state of which the major component may be the $\frac{3}{2}$ $\frac{1}{2}^-$[530] Nilsson state. The 509 keV ($\frac{3}{2}^-$) and 549 keV ($\frac{5}{2}^-$) levels populated in the present experiment are probably members of a β-vibrational band in ^{153}Gd. No explanation is offered for the strongly populated $\frac{5}{2}^-$ level at 531 keV. (auth)

17256 LEVELS OF ^{180}W FROM THE DECAY OF ^{180}Ta. Gujrathi, S. C.; Mark, S. K. (McGill Univ., Montreal). Can. J. Phys.; 51: No. 3, 241-256(1 Feb 1973).

Gamma rays from the decay of 10.5 min ^{180}Ta were studied using high resolution Ge(Li) detectors. More than 90 gamma rays were observed. Several photo-peaks previously reported as single lines were found to be close doublets. The results of this study were correlated with the published $\gamma-\gamma$ coincidence data and the recent (d,d') reaction work, and a decay scheme for ^{180}Ta was constructed. The scheme incorporates more than 85 transitions among 23 excited states in ^{180}W. The level at 1661 keV was discussed in terms of a two-proton quasi-particle state arising from the Nilsson orbitals $\Omega^\pi[Nn_z\Lambda] = \frac{7}{2}^+$ [404] and $\frac{1}{2}^+$ [411]. Several transition probabilities were extracted and compared with other recent experimental data and with the calculations of Kumar and Baranger as well as with the predictions of various phenomenological models. (auth)

17257 DECAY OF ^{160}Eu. D'Auria, J. M.; Guy, R. D.; Gujrathi, S. C. (Simon Fraser Univ., Burnaby, B. C.). Can. J. Phys.; 51: No. 6, 686-695(15 Mar 1973).

A spectroscopic study of the decay of ^{160}Eu to the levels of ^{160}Gd was performed with sources produced from the (n,p) reaction on both enriched and natural gadolinium targets. Employing both β and γ spectrometers, singly and in coincidence, a decay scheme is proposed with 8 levels in ^{160}Gd populated up to an energy of 1997 keV. The half-life was measured to be 50 ± 10 s with a Q_{β^-} deduced to be 3.9 ± 0.3 MeV. A second, unidentified component was observed with a half-life of 8.0 ± 1 min, along with 7 γ rays. The possibility of a two-proton quasiparticle state in ^{160}Gd is discussed. (auth)

17258 HALF-LIFE OF ^{181}W. Myers, W. A.; Nagle, R. J. (Univ. of California, Livermore). J. Inorg. Nucl. Chem.; 35: No. 12, 3985-3989(Dec 1973).

The decay of five samples of ^{181}W was followed for almost two years. The half-life was determined to be 120.95 ± 0.02 days. This half-life is in agreement with that previously used at the Lawrence Livermore Laboratory but differs by 15 percent from the currently accepted value. (auth)

17259 OBSERVATION OF BACK- AND FORWARDBENDING IN THE ^{182}Os GROUND-STATE BAND. Davidson, W. F.; Lieder, R. M.; Beuscher, H.; Neskakis, A.; Seres, Z.; Mayer-Boericke, C. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 264: No. 3, 235-240(1973).

From a study of the γ-decay of high-spin states populated using the (α,8n) reaction, the ground-state rotational band in ^{182}Os has been established up to spin 20. A plot of the moment of inertia as a function of the square of the rotational frequency for this ground-state band results in a back- and forwardbending curve, indicating that an explanation in terms of pure Coriolis decoupling in the $i(13/2)$ neutron orbital requires revision. The moment of inertia reaches a maximum of only 74% of the rigid rotor value. (auth)

17260 INTERNAL CONVERSION COEFFICIENTS OF THE K-FORBIDDEN M1 TRANSITIONS IN ^{169}Tm. El-Nesr, M. S.; Bashandy, E. (Atomic Energy Establishment, Cairo). Atomkernenergie; 22: No. 1, 59-61(Sep 1973).

The K-conversion coefficients of the K-forbidden 177 and 198 keV M1 transitions in ^{169}Tm have been measured by means of the electron–electron coincidence method. The results obtained α_K (177 keV) = 0.52 ± 0.03, α_K (198 keV) = 0.39 ± 0.02 are found to be normal. No penetration effects are shown in the conversion process which result is in agreement with the directional correlation experiments. (auth)

17261 ENERGY LEVELS OF ^{175}Hf. Zaitz, J. I. (Florida State Univ., Tallahassee); Sheline, R. K.; Griffioen, R. D. Z. Phys.; 264: No. 3, 227-234(1973).

The reaction ^{176}Hf(d,t)^{175}Hf was studied using 12 MeV deuterons from the Florida State University super FN tandem Van de Graaff accelerator. The outgoing tritons were analyzed by means of a Browne–Buechner type broad range magnetic spectrograph. Twenty-four states in ^{175}Hf have been identified and fifteen states have been given wave function assignments on the basis of the spectroscopy associated with rotational band structure in deformed odd-A nuclei. The Q-value for the reaction was measured to be −1925 ± 8 keV. (auth)

17262 EFFECT OF NUCLEAR ORIENTATION ON ALPHA AND PROTON SCATTERING FROM ^{165}Ho. Parks, D. R. Stanford, CA; Stanford Univ. (1973). 145p. University Microfilms Order No. 73-30,458.

Thesis (Ph. D.).

The scattering of alpha particles and protons from aligned and unaligned ^{165}Ho nuclei was measured from 14 to 23 MeV alpha particle energy and from 5.5 to 14.5 MeV proton energy. The target was a thick single crystal of ^{165}Ho attached to the mixing chamber of a ^{3}He-^{4}He dilution refrigerator. A temperature of about 0.2°K was maintained in the target crystal; at this temperature the statistical tensor describing the nuclear alignment is $B_{20} = -0.35\ B_{20(max)}$. Scattered alpha particles were detected at an angle of 160°; scattered protons were detected at 160 and 135°. The particle detectors were ultrapure-germanium diodes operated at a temperature of 10°K. Differences as large as 13% between the cross sections of the aligned and the unaligned holmium were measured with alpha particles. For protons, differences as large as 8% were measured. The alpha-particle data were analyzed in terms of the deformed optical model with a coupled-channel formalism. Two optical model parameter sets, which had provided equally good fits to data on elastic and inelastic scattering from rare earth nuclei, were used in the analysis of the aligned-target data. The parameter set with a real potential well depth U = 50.0 MeV and imaginary well depth W = 11.2 MeV gave a good fit to the data, while the other set gave a very poor fit. This result resolves the ambiguity in optical model parameters for scattering of low energy alpha particles from rare earth nuclei. The alpha particle data gave an estimate of the nuclear deformation parameter for ^{165}Ho of $\beta_2 = 0.288 \pm 0.012$. The data taken at proton energies below 8 MeV were analyzed to give an estimate of the intrinsic electric quadrupole moment for ^{165}Ho of $Q_0 = 8.80 \pm 0.52$ barn. Optical model parameters derived from those used previously to fit ^{165}Ho + p elastic and inelastic scattering data were employed in coupled-channel calculations. The best fit to the proton data was obtained with $\beta_2 = 0.203 \pm 0.008$. (Diss. Abstr. Int., B)

17263 INVESTIGATION OF THE INTERNAL CONVERSION ELECTRON SPECTRUM OF ^{184}Re. Ageev, V. A.; Gavrilyuk, V. I.; Klyuchnikov, A. A.; Kupryashkin, V. T.; Latyshev, G. D.; Maidanyuk, V. K.; Makovetskii, Yu. V.; Feoktistov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1684-1691(Aug 1973). (In Russian).

Individual parts of the internal electron conversion spectrum of ^{184}Re were investigated. The energies, relative intensities of the K and γ lines, and the internal conversion coefficients were determined. The decay scheme of ^{184}Re is given. Intensity ratios of the conversion lines and the multipolarities were given for some transitions. (JSR)

17264 INVESTIGATION OF THE DECAY SCHEME OF ^{171}W BY MEANS OF $\gamma-\gamma$ COINCIDENCES. Berlovich, E. E.; Lukashevich, V. V.; Golos, S. D.; Elkin, Yu. V.; Ignatenko, E. I.; Mezilev, K. A.; Tarasov, V. K. (Leningrad Inst. of Nuclear Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1662-1665(Aug 1973). (In Russian).

The γ spectrum and $\gamma-\gamma$ coincidences of ^{171}W were measured with a Ge(Li) detector. A level scheme was proposed for ^{171}Ta. (tr-auth)

17265 NUCLEAR REACTION STUDIES OF ^{151}Sm. Nelson, D. E.; Burke, D. G.; Waddington, J. C.; Cook, W. B. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 18, 2000-2022 (15 Sep 1973).

Properties of nuclear levels in ^{151}Sm were studied by measuring angular distribution for the ^{152}Sm(d,t)^{151}Sm reaction and spectra at several angles for the ^{152}Sm(^{3}He,α)^{151}Sm and ^{150}Sm(d,p)^{151}Sm reactions. The reaction products were analyzed with a magnetic spectrograph and detected with photographic emulsions. Transfer l values were deduced from the (d,t) angular distributions and from the ratios of (^{3}He,α) and (d,t) cross sections. The (d,t), (d,p), and (^{3}He,α) reactions on targets of ^{151}Sm were also studied in order to learn more about the wave function of the ^{151}Sm ground state. The low-lying positive parity levels can be described by the Nilsson model with Coriolis and $\Delta N = 2$ interactions included. However, the properties of the low energy negative parity states could not be explained as easily. No mixture of Nilsson states was found which could simultaneously explain the single neutron transfer intensities and the Coulomb excitation probabilities from previous measurements. (auth)

17266 POLARIZATION EFFECTS ON THE FT VALUES OF THE BETA TRANSITIONS TO ^{155}Gd. Bogdan, D. (Institutul de Fizica Atomica, Bucharest); Cretu, T.; Macarie, G. Z. Phys.; 265: No. 4, 385-392(Nov 1973).

A good agreement between theory and experiment is achieved if besides the Coriolis force effect, the centrifugal and spin–

spin polarization effects are considered in the calculation of the absolute ft values for the $\Delta N = 2$ β transitions $^{155}Eu \rightarrow {}^{155}Gd$. An important improvement is also obtained for the first forbidden transitions if the spin–spin polarization effects are taken into account. (GE)

17267 INTENSITY OF ELECTROMAGNETIC TRANSITIONS IN NUCLEI WITH A > 40. Bertrand, F. (CEN, Limeil, France); Martinot, M.; Verges, N. pp 353-363 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

Evaluations of spectra of neutrons and gamma rays emitted by nuclei are generally based on the use of a statistical model. For calculations one needs to know the partial widths, Γ_n et Γ_γ, relative to the emission of neutrons and gamma rays. There are fairly satisfactory ways (optical model) for estimating (Γ_n), but there is no single model for interpreting radiative widths correctly. The study published by Skorka et al. (Nuclear Data) for light nuclei ($A \leq 40$) showed in particular that the reduced transition probabilities B(E1) and B(E2) are, on the average, of the order of 0.0026 and 2.5 Weisskopf units. In the present paper more than 10,000 data items on electromagnetic transition intensities in nuclei of mass number greater than 40 are assembled, and the mean lives, τ_γ, the reduced transition probabilities, and the transition intensities (in Weisskopf units, with a statistical factor S = 1) are deduced from them. A mean value of these quantities is proposed for each of the transitions studied. The frequency functions of transition intensities of given multipolarity and parity are studied. The influence of the mass number on these frequency functions is examined. (5 figures, 1 table) (auth)

17268 CALCULATIONS OF SPALLATION YIELDS OF PRODUCTS INDUCED BY THE INTERACTION OF HIGH-ENERGY PROTONS WITH COMPLEX NUCLEI. Ross, E.; Baechmann, K. (Technische Hochschule, Darmstadt, Ger.). pp 437-447 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

A number of cross sections for nuclides produced by the interaction of high-energy protons (300 MeV, 580 MeV, 19 GeV) with tantalum and (580 MeV) with gold was determined. The Rudstam formula, which is not valid for elements with atomic number Z > 50 and proton energies > 500 MeV, was improved. The parameter P is given as a function of E_p and A_T (mass number of the target nucleus). The parameter T (being constant in the Rudstam formula) is given as function of the mass difference between A_T and A_p (mass number of the product). It is demonstrated that the improved formula fits the experimental data over a large range of proton energies and target nuclei very well (±20%). Comparison between the formula of Rudstam, Silberberg and Tsao, and this formula was carried out. The improved equations are suitable for calculating yields of nuclides produced in accelerator materials. Cross sections for products induced by cosmic rays can be calculated. (8 figures, 3 tables) (auth)

17269 ANOMALY IN TWO-NEUTRON TRANSFER CROSS SECTION SYSTEMATICS IN DEFORMED NUCLEI. Casten, R. F.; Garrett, J. D. (Brookhaven National Lab., Upton, NY). Phys. Lett.; 47B: No. 5, 436-438(10 Dec 1973).

The cross section ratios $\sigma(4_g^+)/\sigma(2_g^+)$ and $\sigma(2_\gamma^+)/\sigma(2_g^+)$ are nearly an order of magnitude larger in the $^{182}W(t,p)^{184}W$ reaction than for other measured cases of the (t,p) or (p,t) reactions in the rare earth and actinide deformed regions. On both relative and absolute scales the 2_g^+ state of ^{184}W is anomalously weakly populated in $^{182}W(t,p)$ while the 4_g^+ and 2_γ^+ states are enhanced relative to the ground-state transition. (auth)

17270 ABSOLUTE ISOTOPIC ABUNDANCE RATIO AND ATOMIC WEIGHT OF A REFERENCE SAMPLE OF RHENIUM. Gramlich, J. W.; Murphy, T. J.; Garner, E. L.; Shields, W. R. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 77A: No. 6, 691-698(1973).

An absolute value was obtained for the isotopic abundance ratio of a reference sample of rhenium by using surface emission mass spectrometry. Samples of known isotopic composition, prepared from nearly isotopically pure separated rhenium isotopes, were used to calibrate the mass spectrometers. The resulting absolute $^{185}Re/^{187}Re$ ratio is 0.59738 ± 0.00039, which yields atom percents of ^{185}Re = 37.398 ± 0.016 and ^{187}Re = 62.602 ± 0.016. The atomic weight calculated from this isotopic composition is 186.20679 ± 0.00031. The indicated uncertainties are overall limits of error based on 95 percent confidence limits for the mean and allowances for the effects of known sources of possible systematic error. (7 tables) (auth)

17271 NUCLEAR DATA SHEETS FOR A = 188. Schmorak, M. R. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 10: No. 6, 553-593(Dec 1973).

The available experimental data pertaining to the structure of nuclei with A = 188 are compiled; the results from various decay and reaction measurements are compared and evaluated. Inconsistencies and discrepancies in the level schemes are discussed. Level properties and gamma-ray properties are presented. Level schemes for each of the A = 188 nuclei are presented first. Then, for each nucleus, are presented summaries of level properties and compilers' comments, followed by the experimental data and a reference list. Data received before August 1973 are included. (auth)

17272 NUCLEAR DATA SHEETS FOR A = 174. Minor, W. M. (Los Alamos Scientific Lab., NM). Nucl. Data Sheets; 10: No. 5, 515-552(Nov 1973).

The 1965 version of the Nuclear Data Sheets for A = 174 was revised on the basis of experimental data received prior to May 1, 1972. Nine nuclei are known for A = 174. Only the α decays and half-lives are known for ^{174}Os, ^{174}Ir, and ^{174}Pt. Consistent decay schemes for ^{174}Tm, ^{174}Lu, and 142-d ^{174m}Lu and levels in ^{174}Yb, ^{174}Lu, ^{174}Hf, and ^{174}W from reaction studies are presented. The ($\epsilon^+\beta^+$) decay of ^{174}Ta is not well known, presumably because of competition from decays of ^{175}Ta and ^{176}Ta. A number of states in ^{174}Hf from this decay, however, are consistent with levels established in reaction studies. Study of isotope-separated ^{174}Ta activity would probably remove the uncertainties in the present data. (auth)

17273 NUCLEAR DATA SHEETS FOR A = 153. Kroger, L. A.; Reich, C. W. (Aerojet Nuclear Co., Idaho Falls, ID). Nucl. Data Sheets; 10: No. 5, 429-513(Nov 1973).

A compilation of experimental data on nuclides with mass number A = 153 is presented. The compilation constitutes an updating of the previous A = 153 data compilation, which appeared in the Nuclear Data Sheets in November 1963. The cutoff date for the data included in this compilation is approximately June 1, 1972. Data are included for 9 nuclides, ^{153}Pm(Z = 61) through ^{153}Tm(Z = 69). Direct measurements of the ground-state spins now exist for the Z = 62 through Z = 66 members of this A-chain. Changed from the 1963 version are the ground-state parity assignments for ^{153}Sm and ^{153}Gd, given here as π = + for ^{153}Sm and π = – for ^{153}Gd. The availability of data from high-resolution neutron-capture γ-ray spectroscopy, single-nucleon-transfer reactions, and (α,xn) reactions since the last compilation has provided a much more complete picture of the energy-level structure of these nuclei. Based on the present data, there is evidence for well-developed rotational-band structure in ^{153}Sm and ^{153}Eu. In these cases energy-level systematics are treated in terms of the Nilsson model including various well-established couplings. While well-developed rotational-band structure is also observed in ^{153}Gd, suggesting the existence of a deformed equilibrium shape, attempts to make configuration assignments to some of the lower-lying states in terms of a deformed-nucleus coupling scheme have encountered serious difficulties. In addition, it has not yet been possible to provide an interpretation of all the currently available data on the energy levels above approximately 0.4 MeV in ^{153}Eu in terms of the expected single-particle and vibrational configurations. An attempt was made to provide absolute β- and γ-branching ratios on the decay-scheme drawings. In ^{153}Sm β decay, where two essentially independent types of measurements for determining β-branching ratios exist and give consistent results, the β- and γ-branching ratios are considered well established. In the β decay of ^{153}Pm and the ϵ decay of ^{153}Gd, ^{153}Tb, and ^{153}Dy, it has been necessary to rely on indirect means to estimate branching ratios. The methods employed to do this are discussed in connection with the specific nuclides. (auth)

17274 DECAY OF ^{151}Pm TO LEVELS IN ^{151}Sm. Cook, W. B.; Waddington, J. C.; Burke, D. G.; Nelson, D. E. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 18, 1978-1999(15 Sep 1973).

The energy levels of ^{151}Sm were investigated through a study of the decay of 28.4 h ^{151}Pm. Singles gamma-ray spectra were obtained with high resolution Ge(Li) detectors having volumes of 0.9 and 12 cm^3. Two Ge(Li) coincidence spectrometers (37 cm^3 – 50 cm^3 and 0.9 cm^3 – 50 cm^3) operated in a two-parameter configuration (4096 × 4096) were employed in collecting coincidence data. Two hundred and seventeen transitions were incorporated into a level scheme involving 39 levels in ^{151}Sm. On the basis of beta and gamma selection rules, spin-parity assignments were suggested for most of the levels. (auth)

17275 SMALL ANGLE ELASTIC SCATTERING OF 4.3 MeV NEUTRONS FROM U, Bi, AND Pb. Martin, P. W.; McFadden, R.;

White, B. L. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 51: No. 20, 2197-2201(15 Oct 1973).

The differential cross sections for 4.3-MeV neutrons elastically scattered from natural samples of U, Bi, and Pb were measured at laboratory angles of 5, 10, and 15. In the case of uranium, the data are consistent with calculations based on the nuclear optical model and known electromagnetic interactions. Less satisfactory agreement to the data is obtained in the cross section measurements for lead and bismuth. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 15700, 17203, 17209, 17217, 17224, and 17252.

17276 (CONF-730134-, pp vp Paper 11) HYBRID AND GEOMETRY DEPENDENT HYBRID MODELS. Blann, M. (Univ. of Rochester, NY). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Several formulations of models which are intended to permit an a-priori calculation of spectra due to pre-equilibrium decay in nuclear reactions are discussed. These models are capable of giving the time dependence of the equilibrium process and of illustrating the influence of various nuclear parameters on the decay process. Alpha and proton reactions on gold-197 at 10 to 80 MeV and alpha reactions with cobalt-60, nickel-58 and -60, copper-63, and 65, niobium-93, rhenium-103, paladium-105, and platinum-195 at 42 MeV are studied for their cross sections, and the Fermi density dependence for polonium-210 versus radius is found. (JFP)

17277 (COO-3496-30) ENERGY DEPENDENCE OF Γ_f/Γ_n FOR THE NUCLEUS ^{216}Rn. Freiesleben, H.; Britt, H. C.; Huizenga, J. R. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). 1973. Contract AT(11-1)-3496. 18p. (CONF-730823-22; SM-174-56). Dep. NTIS $3.00.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

The ^{209}Bi + ^{7}Li reaction was used to determine experimentally Γ_f/Γ_n for the initial compound nucleus ^{216}Rn. Cross sections for the (^{7}Li,f) reaction were measured at bombarding energies between 24 and 34 MeV by detecting coincident fission fragments. All the other components of the total reaction cross section are due to (^{7}Li,xn), (^{7}Li,txn) and (^{7}Li,αxn) reactions. They were determined by observing known energy alpha particles from the short lifetime decays of various Rn, At and Po isotopes. The background due to prompt reaction particles was eliminated by using a pulsed ^{7}Li-beam and detecting the decay particles between beam pulses. Correction for the effects of second chance fission was obtained from measurements of cross sections for the (^{6}Li,f) and (^{6}Li,xn) reactions at appropriate energies. The results give a direct measurement of Γ_f/Γ_n since both fission and neutron evaporation cross sections were determined. The experimental values of Γ_f/Γ_n for ^{216}Rn and earlier data for ^{210}Po are analyzed with a J dependent statistical model and the effect of incorporating an enhancement of the level density at the saddle point due to coupling to collective rotations is investigated. Fission barriers extracted with a variety of assumptions about the level densities are compared with theoretical predictions. (auth)

17278 (IPNO-RC-73-5) EXCITATION FUNCTIONS AND RECOIL RANGES OF RESIDUAL NUCLEI PRODUCED THROUGH Kr INDUCED TRANSFER REACTIONS IN ^{209}Bi TARGETS. Bimbot, R.; Rivet, M. F. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

The excitation functions and projected recoil ranges for ^{211}At, ^{210}Rn and ^{211}Rn produced through ^{84}Kr + ^{209}Bi reactions were measured from 430 to 500 MeV. The general features of the reactions (the shapes of the excitation functions, and the variation of recoil range versus incident energy) are very similar to results obtained with lighter projectiles and are unambiguously characteristic of noncompound-nucleus processes. Complementary measurements performed on a natural Tl target show that the cross sections for 4 charge and 5 charge transfer reactions are of the order of 1mb. Therefore, in the reactions ^{84}Kr + ^{209}Bi → $^{210-211}$Rn, the contribution of the 4 and 5 charge transfers followed by fast α decay is not significant, and the main mechanisms involved are the transfers of 2 and 3 charges. (auth)

17279 RADIOACTIVE ^{203}Au. Bunus, F. T. (Institutul de Fizica Atomica, Bucharest). Radiochim. Acta; 18: No. 4, 192-194(1973).

The half-life and emission of ^{203}Au were measured based on ^{204}Hg(n,d)^{203}Au nuclear reaction in natural mercury. Irradiations with 14.5 MeV neutrons, followed by gamma spectrometry and beta counting (separation mercury – gold), allowed the determination of the values mentioned: half-life 53 ± 2 sec, gamma quanta 0.69 MeV, E_{max} for betas 2 MeV. At the same time, the measurement of the cross section for the (n,d) reaction yields the value: 0.5 ± 0.1 mb. (GE)

17280 DIRECT AND COMPOUND CONTRIBUTIONS TO (n,γ) CROSS SECTIONS. Mantzouranis, G. (Univ., Heidelberg). Z. Phys.; 265: No. 1, 405-411(Oct 1973).

The direct and compound nucleus contributions to the ^{208}Pb(n,γ)^{209}Pb reaction were investigated in the region 2.25–7.25 MeV. A modified Hauser–Feshbach theory in the presence of direct reactions was used for the compound nucleus cross sections. The corrections to the traditional Hauser–Feshbach theory are found to be small in this case. (auth)

17281 COMPLEX MICROSCOPIC EFFECTIVE INTERACTION FOR (p,n) REACTIONS. Hoffmann, G. W.; Coker, W. R. (Univ. of Texas, Austin). Phys. Lett.; 47B: No. 4, 285-287(26 Nov 1973).

A simple recipe for generating a complex effective interaction for distorted wave Born approximation calculations from a real, microscopic charge-exchange form factor is investigated. The recipe is tested against angular distribution data for ^{208}Pb(p,n) and ^{209}Bi(p,n) from 25 to 50 MeV incident proton energy. The form factor resulting from the recipe is also compared qualitatively to complex effective coupling potentials, resulting from a charge-independent Lane-model formalism and from coupled-reaction-channels calculations for a suggested multistep (p,d) – (d,n) reaction mechanism. (auth)

17282 ANGULAR CORRELATION OF THE K- AND L- CONVERSION ELECTRONS IN ^{192}Pt. Aldushchenkov, A. V.; Band, I. M.; Voinova, N. A.; Kaminker, D. M.; Listengarten, M. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1652-1661(Aug 1973). (In Russian).

An investigation was made of the angular correlation of the K- and L-conversion electrons in ^{192}Pt using a Si(Li) detector with the purpose of determining the size of the EO component in the $2^{+\prime} \rightarrow 2^{+}$ transition at 296 keV. (JSR)

17283 INELASTIC SCATTERING OF NEUTRONS BY ^{198,200,202}Hg AND ^{206}Pb NUCLEI IN THE ENERGY REGION CLOSE TO THRESHOLD. Koncbeevskii, E. S.; Musaelyan, R. M.; Popov, V. I.; Surkova, I. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1714-1716(Aug 1973). (In Russian).

With the purpose of searching for deviations from the statistical model measurements were made of the inelastic scattering of neutrons on ^{198,200,202}Hg and ^{206}Pb in the energy range from threshold up to 300 keV over the threshold for excitation of the first 2^{+} level. It was observed that with decrease of the mass number a noticeable increase of the cross section was noted not predicted by the statistical model. (tr-auth)

17284 CHARGED-PARTICLE NUCLEAR REACTIONS: COMPILATION, EVALUATION, AND SYSTEMATICS OF EXCITATION FUNCTIONS. Muenzel, H.; Lange, J.; Keller, K. A.; Pfennig, G. (Inst. of Radiochemistry, Karlsruhe, Ger.). pp 509-520 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.2); CONF-730302-(Vol.2).

In many fields of applied science and technology, there is a great need for cross sections to be used for calculating the activity of nuclides produced by charged-particle bombardment. Many attempts are made, therefore, in preparing compilations to ease the access to the data. In this paper, a survey is given on the present situation in respect to the available reference lists, the data compilations, the critical evaluation, and the systematics of excitation functions. (4 figures) (auth)

17285 NUCLEAR SPREADING OF AN ANTI-ANALOG STATE IN ^{209}Bi. Lev, A. (Wayne State Univ., Detroit); Beres, W. P.; Divadeenam, M. Phys. Lett.; 47B: No. 5, 408-410(10 Dec 1973).

The nuclear spreading width of the $2g_{\frac{9}{2}}$ antianalog state in ^{209}Bi is calculated within the particle-vibration intermediate structure scheme. The width is several MeV only in three distinct energy regions. The distribution of the $2g_{\frac{9}{2}}$ strength is also studied. (auth)

17286 γ-RAY PAD PATTERN IN THE PRESENCE OF TWO ISOMERIC LEVELS. Nagamiya, S. (Tokyo Univ.). Nucl. Instrum. Methods; 114: No. 2, 349-356(1974).

In the case where two or more isomeric levels with half-lives comparable to each other exist in the same nucleus, the pulsed-beam experiment often gives a complicated result on the time distribution of the γ ray for the lowest transition. The influences of the presence of two isomeric levels on the measurements of

half-life and g factor are discussed. Formulas for the decay pattern, time-differential PAD pattern, and stroboscopic resonance pattern are presented, and computed results are compared with the experimental data for the nuclei of ^{210}Po and ^{209}Po. (7 figures, 2 tables) (auth)

17287 NUCLEAR DATA SHEETS FOR A = 217. Maples, C. (Univ. of California, Berkeley). Nucl. Data Sheets; 10: No. 6, 611-623(Dec 1973).

The available information on the decay characteristics and level structure for all nuclei with the mass number A = 217 is examined. A summary and evaluation of the experimental data, including adopted values and comparisons with theory, are presented. The individual level schemes are discussed, and comments pertaining to spin and parity assignments and to γ-ray multipolarities are given. Any apparent discrepancies or inconsistencies are pointed out. Most of the level information in the A = 217 mass chain is obtained from the α decay of the A = 221 parent. A number of new ground-state spin and parity assignments are suggested based on favored α transitions. In the case of the ^{217}Rn and ^{217}Fr ground states, these assignments are considered definitive. The tentative spin assignments for the ground states of ^{217}At and ^{217}Ac are due to uncertain ties in the ground-state spin assignments for the ^{213}Bi and ^{213}Fr daughters, respectively. A determination of the ground-state spin of ^{209}At would also determine the ^{217}Ac ground-state spin, via favored α decay. It should be noted that, to some extent, the suggested spin and parity assignments for levels in ^{217}At are correlated with the suggested spin assignments in ^{221}Fr and ^{225}Ac. New information on the spin assignments in these nuclei could therefore affect the proposed assignments in ^{217}At. The level schemes of each of the A = 217 nuclei are shown first, followed by the data used in calculating α-hindrance factors. The information on the respective A = 217 nuclei, listed in order of increasing Z, is presented according to the following format: the experimental decay data and their evaluation; reaction data (if any); a summary of the level properties and spin assignments; a discussion of gamma-ray properties; and compilers' comments. The reference list is given at the end of the A = 217 review. All information obtained prior to May 1973 is included. (auth)

17288 NUCLEAR DATA SHEETS FOR A = 213. Maples, C. (Univ. of California, Berkeley). Nucl. Data Sheets; 10: No. 6, 597-609(Dec 1973).

The available information on the decay characteristics and level structure for all nuclei with the mass number A = 213 is examined. A summary and evaluation of the experimental data, including adopted values and comparisons with theory, are presented. The individual level schemes are discussed, and comments pertaining to spin and parity assignments and to γ-ray multipolarities are given. Any apparent discrepancies or inconsistencies are pointed out. It should be noted that much of the level information in the A = 213 mass chain is obtained from the α decay of the A = 217 parent. Little information is available on the level structure of nuclei with A = 213. Several new ground-state spin and parity assignments are suggested, however, based on favored α transitions and, in some cases, estimates of β branching. In the case of ^{213}Po and ^{213}At, these assignments are considered definitive. A definite determination of the spin and parity of the ^{209}At ground state would also specify the ground-state spins of ^{213}Fr and ^{217}Ac, via favored α decay. The level schemes of each of the A = 213 nuclei are shown first, followed by the data used in calculating α-hindrance factors. The information of the respective A = 213 nuclei, listed in order of increasing Z, is presented according to the following format: the experimental decay data and their evaluation; reaction data (if any); a summary of the level properties and spin assignments; a discussion of gamma-ray properties; and compilers' comments. The reference list is given at the end of the A = 213 review. All information obtained prior to May 1973 is included. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 15253, 15708, 16449, 16450, 17103, 17217, 17252, 17275, 17471, and 17703.

17289 (CONF-730134-, pp vp Paper 1) ELASTIC SCATTERING OF ^{84}Kr BY HEAVY NUCLEI. Colombani, P. (Institut de Physique Nucleaire, Orsay, France). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

A krypton-84 beam is elastically scattered by lead-208, thorium-232, and tantalum-181 and the differential cross sections are found in order to look for deformation effects. It is concluded that the decrease of the radius parameter and the relative increase of the interaction barrier is quite well fitted with a simple spherical model of the two interacting ions system. Also some effects due to deformations clearly appear, but their relative importance seems rather weak. (JFP)

17290 (CONF-730134-, pp vp Paper 22) PROTON-INDUCED FISSION OF URANIUM ISOTOPES 233, 234, 235, 236, AND 238. Bass, R. (Univ., Frankfurt am Main). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Excitation functions and cross sections are found for proton-induced fission of uranium-233, -234, -235, -236, and -238 and neptunium-233, -234, -235, -236, -237, and -238 at 5 to 30 MeV. (JFP)

17291 (CONF-730134-, pp vp Paper 24) STATISTICAL CALCULATIONS OF THE MASS DISTRIBUTION IN FISSION. Jensen, A. S. (NORDITA, Copenhagen). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The probability distribution in the deformation space and the mass distribution are found for plutonium-240 fission. (JFP)

17292 (CONF-730134-, pp vp Paper 25) SYMMETRIC AND ASYMMETRIC FISSION OF AC ISOTOPES NEAR THE FISSION THRESHOLD. Konecny, E. (Technische Univ., Munich); Specht, H. J.; Weber, J. 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Fission probabilities and fragment anisotropies were investigated for fission of ^{227}Ac and ^{228}Ac using direct reactions with a ^{3}He beam on a ^{226}Ra target. Triple-humped mass distributions are found also for excitation energies where second-change fission is excluded. The fission barrier is higher for symmetric fission compared to that for asymmetric fission by 1.2 and 2 MeV, respectively, suggesting that the character of the mass split is already predetermined at the saddle point. (auth)

17293 (CONF-730134-, pp vp Paper 26) CORRELATED EXCITATIONS OF FISSION FRAGMENTS. Signarbieux, C.; Nifenecker, H.; Poitou, J.; Ribrag, M. (CEN, Saclay, France). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Some results obtained at Saclay in correlated measurements of multiplicities of neutrons emitted in spontaneous fission of californium-252 are discussed. (JFP)

17294 (CONF-730134-, pp vp Paper 27) RECENT CALCULATIONS ON THE FISSION OF HEAVY NUCLEI. Nix, J. R. (Los Alamos Scientific Lab., NM). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

A single approach is developed for treating all phenomena associated with changes in nuclear shape and particle numbers for fission, ground-state masses and deformations, and heavy-ion reactions for heavy and superheavy nuclei. Only the outline and diagrams are presented. (JFP)

17295 (CONF-730134-, pp vp Paper 28) EXPERIMENTAL EVIDENCE OF THE (n,γf) REACTION FROM THE STUDY OF PROMPT NEUTRONS AND γ-RAYS EMITTED IN THE FISSION PROCESS. Paya, D. (CEN, Saclay, France). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Some recent results are given which were obtained on the number of gamma rays emitted by the fission fragments in the neutron resonances of plutonium-239 and on the number of neutrons and the gamma ray energy released by the fragments in the same resonances. Evidence is found for the (n,γf) process. (JFP)

17296 (CONF-730134-, pp vp Paper 29) ASYMMETRY IN NUCLEAR FISSION. Mosel, U. (Univ., Giessen, Ger.). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The two-center shell model for fission was generalized to include asymmetric deformations. Potential energy calculations were carried out for lead-202, polonium-210, uranium-236, curium-248, fermium-252, -254, and -264. The occurrences of symmetry and asymmetric fission in the various nuclei are discussed. The structures which appear in the potential-energy surfaces are the results of an interplay between compound-nucleus shell structure, fragment shell structures, and liquid-drop-model energies. It is indicated that the observed mass distribution is correlated with the potential energy surface in the neighborhood of scission. (JFP)

17297 (CONF-730134-, pp vp Paper 38) ZERO-POINT ENERGY PROBLEM IN COLLECTIVE POTENTIALS WITH STRU-

TINSKY RENORMALIZATION. Maruhn, J.; Greiner, W. (Univ., Frankfurt am Main). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

A method for the correct treatment of zero-point vibrations in collective potential energy surfaces calculated according to the Strutinsky prescription is proposed. Its effects on theoretical lifetime predictions are estimated in a simple model. (auth)

17298 (COO-2025-4) ABSOLUTE FISSION CROSS-SECTION MEASUREMENTS. Knoll, G. F. (Michigan Univ., Ann Arbor (USA). Coll. of Engineering). Dec 1973. Contract AT(11-1)-2025. 13p. Dep. NTIS $3.00.

Advances were made over the past year in both new experimental facilities and in important measurements. Facilities were provided for safe handling of plutonium samples, and work is underway on the measurement of the ^{239}Pu fission cross section at 964 keV. A new photoneutron source was also developed and applied in measurements on ^{235}U at 260 keV. Work was completed on a measurement of the ^{6}Li-(n,α) cross section and represents one of the very few absolute measurements made in the keV energy range. Measurements on the ^{235}U fission cross section at 964 keV, largely completed last year, were extended to improve the estimated precision of the result. (auth)

17299 (TID-3317-S4) TRANSPLUTONIUM ELEMENTS. A Bibliography. Stuber, C. E. (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 215p. Dep. NTIS $7.60.

This bibliography comprises 835 references on the transplutonium elements compiled through the period ending June 30, 1973. The references were retrieved from the NSA data base, and subject indexing is displayed under each citation. Part I includes 811 references dealing with the production and chemical, nuclear, physical, and biological properties and health and safety aspects of elements with Z $\geq$ 95. Part II includes 24 references dealing with the natural occurrence of the transplutonium elements. This collection of references is concerned with attempts to locate or prove the existence of the transplutonium elements in nature. Author and subject indexes are included. (RWR)

17300 CHARGE DISPERSION STUDIES OF HEAVY-MASS ELEMENTS IN THE FISSION OF ^{232}Th BY PROTONS OF MEDIUM ENERGY. Holub, R.; Yaffe, L. (McGill Univ., Montreal). J. Inorg. Nucl. Chem.; 35: No. 12, 3991-4000(Dec 1973).

Cross sections for the independent formation of ^{139}Ba, ^{139}Ce, ^{140}La, ^{141}La, ^{141}Ce, and ^{143}Ce and the cumulative formation of ^{139}Cs, ^{140}Ba, ^{140}La, ^{143}Ba, ^{143}Ce, ^{143}La, and ^{144}Ce were determined in the fission of ^{232}Th by protons of energies 28 to 83 MeV. Charge dispersion curves were constructed from these data with slight corrections for the variation of N/Z_p as a function of A. Observations are made about the shapes of the curves obtained if one plots, from the excitation functions, the energy at which a certain fission product will have the maximum yield against its value of N/Z. This is related to the advent of symmetric fission. Observations are also made about charge dispersion curves as a function of single and multi-chance fission. (auth)

17301 CONTRIBUTION OF THE EXCITED STATES IN THE INTERMEDIATE RESONANCES. Saad, E. A.; El Wakil, S. A. (Atomic Energy Establishment, Cairo). Atomkernenergie; 22: No. 1, 51-58(Sep 1973).

The effect of excited states of inelastic scattering is taken into account when the intermediate resonance integral is calculated. The calculation was done in both homogeneous and heterogeneous cases, with and without interference scattering. The effect of inelastic scattering is considered only in the fuel element. The effect was found to vary between 3.2 to 7.4% as the moderator mass increases in the homogeneous system, while in the heterogeneous system, it varies between 7.4 to 1.98% if the fuel is $^{238}UO_2$, and 19.1 to 4.36% if the fuel is ^{238}U. (auth)

17302 MEASUREMENT AND CALCULATION OF INTEGRAL HEAVY-ELEMENT CROSS-SECTION RATIOS IN THE FAST BREEDER REACTOR EBR-II. Dudey, N. D.; Meneghetti, D.; Heinrich, R. R.; Rempert, R. H. (Argonne National Lab., IL). Nucl. Sci. Eng.; 53: No. 1, 9-26(Jan 1974).

Measurements of integral neutron capture-to-fission cross-section ratios and neutron capture rates of ^{233}U, ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu, and ^{242}Pu at 15 radial and axial positions in EBR-II are reported. Fission rates were determined by measurement of the fission product ^{137}Cs, and capture rates were determined by mass-spectrometric and alpha-spectrometric analysis. Capture-to-fission ratios at all sample locations and central fission and capture ratios were calculated by two-dimensional RZ and XY geometries using multigroup analyses. Details of geometry and reactor composition changes during the course of the irradiations are considered and found to be significant for the fertile isotopes. A detailed comparison between measurement and calculation is presented and discussed in terms of the calculational model, cross-section data, and experimental uncertainties. Calculations were made using both Versions I and III of ENDF/B. (17 figures, 9 tables) (auth)

17303 MEASUREMENTS OF EQUILIBRIUM AND TIME-DEPENDENT ENERGY SPECTRA OF BETA RAYS FROM CALIFORNIUM-252 FISSION FRAGMENTS. Knief, R. A.; Wehring, B. W.; Wyman, M. E. (Univ. of Illinois, Urbana). Nucl. Sci. Eng.; 53: No. 1, 47-60(Jan 1974).

Absolute measurements were made for the equilibrium and time-dependent beta-ray energy spectra from fission fragments produced by spontaneous fission of ^{252}Cf. The beta rays were detected by a plastic scintillator, and the fission rate was monitored by a semiconductor detector. The equilibrium spectrum was measured from a ^{252}Cf source permanently encapsulated between two Mylar foils thick enough to stop the fragments. The time-dependent measurements used a ^{252}Cf source supported on a thin nickel foil and covered with a thin collodion foil. Virtually all fragments from this second source escaped the foils. By use of a special transport system, the time dependence of the ^{252}Cf beta-ray energy spectrum was measured for two cases: buildup of the spectrum following initiation of fragment collection on clean catcher foils, and decay of the spectrum following a period of fragment collection. The measured spectra were corrected for energy resolution effects by unfolding them with the use of a measured system response function. The measured data were used to generate empirical expressions for the equilibrium and time-dependent beta-ray spectra from ^{252}Cf fission fragments. The total number of beta rays from one fission was estimated to be 6.7 $\pm$ 0.3, while the total beta-ray energy was estimated to be 6.1 $\pm$ 0.5 MeV. The results of the measurements were compared with the analogous measurements for thermal-neutron fission of ^{235}U. High-energy transitions (5 to 10 MeV) found for ^{235}U fission were not found for ^{252}Cf fission. (11 figures) (auth)

17304 DENSITY OF SUPERHEAVY NUCLEI. Aver'yanov, I. K.; Sadovoi, A. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1705-1707(Aug 1973). (In Russian).

The charge matter distributions for the superheavy nuclei ^{280}112 and ^{408}168, as well as ^{182}Yb, were calculated by the hyperspherical function method using the basic approximations of this method. (tr-auth)

17305 DELBRUCK SCATTERING OF 7.9 MeV PHOTONS. Moreh, R.; Kahana, S. (Negev Nuclear Research Centre, Beersheva, Israel). Phys. Lett., 47B: No. 4, 351-354(26 Nov 1973).

The elastic scattering cross section of 7.9 MeV photons by U and Th was measured in the angular range 25°-140°. It is shown that at this energy the forward elastic scattering is due almost entirely to Delbruck scattering. The results are systematically lower by > 50% than the calculated values. A good agreement with theory was obtained only after excluding the contribution of the real part of the Delbruck scattering amplitude. (auth)

17306 USE OF RESULTS OF INTEGRAL MEASUREMENTS IN DETERMINING MORE PRECISELY THE VALUES OF NEUTRON NUCLEAR CONSTANTS. Reuss, P. (CEN, Saclay, France). pp 189-194 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in Science and Technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.1); CONF-730302-(Vol.1).

Integral neutron measurements may—since very precise codes are now available—provide significant information on nuclear constants. Their analysis performed in this spirit is the logical outcome of important experimental research done on reactors. It does not allow testing all data of the calculation, but only those quantities which are already of a global nature. The analysis dealt with in the present paper, concerning measurements of the Laplacian relating to all thermal-neutron-reactor types, has, above all, confirmed the new normalization of the ^{235}U fission cross section and given rise to a decrease of the ^{238}U effective resonance integral. (auth)

17307 FISSION-PRODUCT CHAIN YIELDS FROM EXPERIMENTS IN THERMAL REACTORS. Crouch, E. A. C. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 393-458 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.1); CONF-730302-(Vol.1).

Published values of the yields of fission products from the thermal-neutron-induced fission of ^{227}Th, ^{229}Th, ^{233}U, ^{235}U, ^{239}Pu, ^{241}Pu, ^{242m}Am, ^{245}Cm, ^{249}Cf and from the "pile"-neutron-induced

fission of ^{227}Ac, ^{231}Pa, ^{232}Th, ^{233}U, ^{237}Np, and ^{241}Am were assessed, and recommended values for the chain yields are listed. (16 tables, 698 references) (auth)

17308 CUMULATIVE YIELDS OF THERMAL NEUTRON FISSION PRODUCTS. Some Results and Recommendations Based on a Recent Evaluation. Walker, W. H. (Chalk River Nuclear Labs, Ont.). pp 459-476 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.1); CONF-730302-(Vol.1).

A careful analysis of cumulative yields in the thermal-neutron fission of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu was recently completed. The methods used and some of the problems encountered are discussed. Errors are assigned to all yields, and the effects of the corresponding uncertainties in neutron absorption and reactivity are estimated. A program of measurements which could reduce the major uncertainties requires mass-spectrometric measurements of radioactive and stable isobars for a given fissile species plus γ-ray measurements for all four fissile species of relative yields for a large number of radioactive nuclides that are isobaric with nuclides for which the yields have been measured mass-spectrometrically. These measurements are discussed, and recommendations are made for presentation of data in a way that will minimize uncertainties in future evaluations. (2 figures, 5 tables) (auth)

17309 DISCUSSION OF FISSION-PRODUCT YIELD EVALUATION METHODS AND A NEW EVALUATION. Lammer, M.; Eder, O. J. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf, Austria). pp 505-551 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol.1); CONF-730302-(Vol.1).

Reliable data on fission product yields are necessary for interpretation of gamma-spectrometric measurements on burnt fuel elements. Discrepancies among sets of fission yields recommended by different evaluators led to a detailed study of published experimental data. A new evaluation was performed. After a comprehensive description of the present state of experimental methods for obtaining fission product yields, the previously adopted evaluation procedures are critically reviewed. An evaluation procedure is proposed which takes into account sources of experimental errors and accuracies of methods used. Examples of recently evaluated fission product yields for thermal fission of ^{233}U, ^{235}U, and ^{239}Pu and for fast fission of ^{232}Th are presented. (7 tables, 118 references) (auth)

17310 SYSTEMATICS OF NEUTRON EMISSION PROBABILITIES FROM DELAYED NEUTRON PRECURSORS. Kratz, K. L.; Herrmann, G. (Univ., Mainz). Z. Phys.; 263: No. 5, 435-442 (1973).

A simple correlation based on the gross theory of β-decay is derived between the neutron emission probabilities P_n of delayed neutron precursors, their β-decay energies and the neutron binding energies of the daughter nuclei. The correlation is shown to be valid for delayed neutron precursors among the fission products. The P_n values of several expected but still unidentified neutron precursors are estimated together with their contributions to the delayed neutron groups in thermal-neutron-induced fission of ^{235}U. Some aspects of the β-strength function for transitions into highly excited states are discussed. (1 figure, 2 tables) (auth)

17311 STUDY OF SPONTANEOUS FISSION OF ^{252}Cf. Zakharova, V. P.; Ryazanov, D. K.; Basova, B. G.; Rabinovich, A. D.; Korostylev, V. A. Yadern. Fiz.; 18: No. 6, 1145-1156(Dec 1973). (In Russian).

The energy and mass spectra of fragments from ^{252}Cf spontaneous fission were studied. It has turned out that some of the energy spectra can be represented as a super-position of separate components. This effect is especially strong in the regions 160.5-162 and 88.5-90 a. u. of the fragment masses. The possible sources of these effects are discussed. Some general characteristics of energy distributions are also presented along with the data of other authors. (auth)

17312 SEARCH FOR A γ-BRANCH FROM SHAPE ISOMERS IN ^{236}U AND ^{238}Np. Borggreen, J.; Hattula, J.; Kashy, E.; Maarbjerg, V. (Univ. of Copenhagen). Nucl. Phys.; A218: No. 3, 621-628(1974).

A search for γ-decay from the shape isomer in ^{236}U ($t_{\frac{1}{2}}$ = 130 ns) and in ^{238}Np (hypothetical) was performed in the reactions ^{235}U(d,p) ^{236}U and ^{236}U(p,n)^{238}Np by the use of a pulsed beam. In both cases there are possible candidates, but no definite γ-decay was established. The experiments yield limits on production cross sections, which are higher than the theoretical estimates. (auth)

17313 NUCLEAR DATA SHEETS FOR A = 225. Maples, C. (Univ. of California, Berkeley). Nucl. Data Sheets; 10: No. 6, 643-671(Dec 1973).

The available information on the decay characteristics and level structure for all nuclei with the mass number A = 225 is examined. A summary and evaluation of the experimental data, including adopted values and comparisons with theory, are presented. The individual level schemes are discussed, and comments pertaining to spin and parity assignments and to γ-ray multipolarities are given. Any apparent discrepancies or inconsistencies are pointed out. It should be noted that most of the level information in the A = 225 mass chain is obtained from the α decay of the A = 229 parent. Any information concerning the decay of nuclei with A = 229 which is used in constructing the A = 225 decay schemes and which has become available since the A = 229 compilation of 1971 (71E111) is referenced explicitly in the discussion of the particular A = 225 decay scheme. There has been considerable disagreement in the literature concerning the parity of the ^{225}Ac g.s. The spin and parity assignments proposed by the compilers for levels in ^{225}Ac are consistent with, and strongly linked to, the spin and parity assignments proposed for the ^{221}Fr daughter and ^{217}At granddaughter. Any new information which would alter the assignments in these isotopes might, therefore, affect the parity assignments (and hence the rotational band designations) in ^{225}Ac. It should also be noted that the characterization of the favored rotational band in ^{225}Ac permits a tentative new assignment of 5/2+[642] for the previously uncharacterized ^{229}Pa g.s. (see 71E111). The level schemes of each of the A = 225 nuclei are shown first, followed by the data used in calculating α-hindrance factors. The information on the respective A = 225 nuclei, listed in order of increasing Z, is presented according to the following format: the experimental decay data and their evaluation; reaction data (if any); a summary of the level properties and spin assignments; a discussion of gamma-ray properties; and compilers' comments. The reference list is given at the end of the A = 225 review. All information obtained prior to May 1973 is included. (auth)

17314 NUCLEAR DATA SHEETS FOR A = 221. Maples, C. (Univ. of California, Berkeley). Nucl. Data Sheets; 10: No. 6, 625-641(Dec 1973).

The available information on the decay characteristics and level structure for all nuclei with the mass number A = 221 is examined. A summary and evaluation of the experimental data, including adopted values and comparisons with theory, are presented. The individual level schemes are discussed, and comments pertaining to spin and parity assignments and to γ-ray multipolarities are given. Any apparent discrepancies or inconsistencies are pointed out. It should be noted that most of the level information in the A = 221 mass chain is obtained from the α decay of the A = 225 parent. The spin and parity of the ^{221}Fr g.s. has been the subject of much discussion in the literature. The spin assignments for the levels in ^{221}Fr are highly correlated with spin and parity assignments suggested by the compilers in both the ^{225}Ac parent (particularly the g.s.) and the ^{217}At daughter (particularly the 217.6-keV level). The spin assignments proposed for the levels in ^{221}Fr must, therefore, be consistent with the available information on both the parent and the daughter. It should therefore be noted that any new information which would alter the suggested spin assignments in either of these nuclei may necessitate changes in the proposed assignments for ^{221}Fr. The level schemes of each of the A = 221 nuclei are shown first, followed by the data used in calculating α-hindrance factors. The information on the respective A = 221 nuclei, listed in order of increasing Z, is presented according to the following format: the experimental decay data and their evaluation; reaction data (if any); a summary of the level properties and spin assignments; a discussion of gamma-ray properties; and compilers' comments. The reference list is given at the end of the A = 221 review. All information obtained prior to May 1973 is included. (auth)

Nuclear Theory

Refer also to abstracts 16960 and 17024.

17315 (AECL-4602) RELATIONSHIP BETWEEN THE SPHERICAL SHELL MODEL AND THE DEFORMED HARTREE-FOCK MODEL FOR NUCLEI. Harvey, M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1973. 27p. (CONF-730673-2). Dep. NTIS (U. S. Sales Only) $3.50. AECL $1.00.

From Canadian Association of Physicists meeting; Montreal, Canada (18 Jun 1973).

A definition of the spherical shell model Hamiltonian is given for nuclei in which the Hartree-Fock field is deformed; this definition is consistent with the usual phenomenological parametrization. Calculated single particle energies in an individual particle model and in a shell model with residual interaction are presented. A new approach to describing deformation effects in the spherical shell model is presented in terms of the deformation of the Hartree-Fock field. A comparison is shown between the results of projected unrestricted Hartree-Fock calculations and the new deformation-renormalized spherical shell model. A "shape-dependent" effective interaction for the spherical shell model is suggested. (auth)

17316 (CONF-730134-, pp vp Paper 15) EXCITON MODEL AND THE ANALYSIS OF PROTON INDUCED REACTIONS. Gadioli, E. (Univ., Milan). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The exciton model for (p,xn) reactions allow one to estimate at each energy an upper limit for the compound nucleus formation cross section. Excitation functions are also found. (JFP)

17317 (CONF-730134-, pp vp Paper 16) FLUCTUATIONS IN THE STATISTICAL THEORY OF PRE-EQUILIBRIUM NUCLEAR REACTIONS. Gadioli-Erba, E.; Sona, P. G. (CISE, Milan). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The theory of statistical interference effect and of the resulting fluctuations in cross sections of pre-equilibrium nuclear reactions is sketched in the typical case of (n,p) and (p,n) reactions at 20 to 30 MeV excitation energy. Good resolution experiments should show this type of fluctuations. (auth)

17318 (CONF-730134-, pp vp Paper 17) EFFECT OF DIRECT REACTIONS ON AVERAGE CROSS-SECTIONS AND FLUCTUATIONS. Engelbrecht, C. A. (Atomic Energy Board, Pelindaba, S. Afr.). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The discussion of the effect of direct reactions on the average cross sections and fluctuations covers the transformation of the S-matrix to diagonal form, sum rule and consistency conditions, properties of the resonance parameters, multi-channel limit, and cross section fluctuations. (JFP)

17319 (CONF-730134-, pp vp Paper 18) INVESTIGATION OF UNBOUND PARTICLE AND HOLE STATES BY DIRECT REACTIONS. Lipperheide, R. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Particle and hole states of nuclei as they are observed in the final channels direct transfer reactions are considered. In particular those states which have a continuous energy distribution, i.e., states which decay by particle emission. Deuteron and neutron reactions with nitrogen-15 and proton reactions with oxygen-16 below 50 MeV are considered. (JFP)

17320 (CONF-730134-, pp vp Paper 19) CHANNEL–CHANNEL CORRELATIONS INDUCED BY ISOBARIC ANALOGUE RESONANCES IN THE COMPOUND NUCLEUS DECAY. Mudersbach, K.; Wurm, J. P.; Zoran, V. (Max-Planck-Institut fuer Kernphysik, Heidelberg). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

With recent emendations to the Hauser–Feshbach theory when direct reactions are present as a basis, it is shown that polarization measurements could provide a test of the channel–channel correlations induced by isobaric analog resonances in compound nucleus decay. An order-of-magnitude calculation of the polarization due to the enhancement for the inelastically scattered protons on the $d_{\frac{5}{2}}$ IAR at 7.61 MeV in $^{90}Zr + p$ is made. It is inferred that, for cases in which the IAR is a strong doorway for more inelastic channels, the deviations from the statistical model could be measured. (auth)

17321 (CONF-730134-, pp vp Paper 21) FUSION REACTIONS BETWEEN COMPLEX NUCLEI. Lefort, M.; Le Beyec, Y.; Peter, J. (Institut de Physique Nucleaire, Orsay, France). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The discussion of fusion reactions between complex nuclei covers the height of the barrier of interaction and complete fusion limits due to the orbital angular momentum of the projectile. The cross sections are found. (JFP)

17322 (CONF-730134-, pp vp Paper 23) ARE THERE TRANSMISSION RESONANCES IN THE SUPER BARRIER FISSION PROCESS? Hofmann, H. (Technische Univ., Munich). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The ratio of the diffuseness D to the total width W, which is r = D/W, is used to determine the existence of transmission resonances of the collective potential barrier in super barrier fission. A Woods–Saxon potential is used to find the critical value of r for which one can find at least one peak in the penetrability function. (JFP)

17323 (CONF-730134-, pp vp Paper 30) INFORMATION ON SCISSION STAGE FROM TERNARY FISSION EXPERIMENTAL DATA. Pinelli, T. (Univ., Pavia, Italy). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

A review is given of progress on the determination of the scission stage from ternary fission data. (JFP)

17324 (CONF-730134-, pp vp Paper 31) DEVIATIONS FROM AXIAL SYMMETRY AT SCISSION. Schultheis, R. (Univ., Munich). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

The potential energy of the scission-point configuration allowing for gamma deformations is calculated for every charge and mass number from Schmitt's table of energetically favored even–even fission models of uranium-236. It is found that the potential energy favors axial asymmetry for the fragment xenon-138 and axial symmetry for all others. Also the stiffness against gamma distortions is plotted against the fragment mass number. (JFP)

17325 (CONF-730134-, pp vp Paper 37) RELATION OF THE STRUTINSKY-AVERAGING METHOD TO THE GENERALIZED THOMAS–FERMI MODEL. Gross, D. H. E. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). 1973.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

Strutinsky averaging is discussed in terms of simple physical pictures, and the results are reported. Restriction is made to the problem of the smoothed part of the level density of independent particles in an arbitrary potential. It is found that the Strutinsky averaging model just leads to the statistical model inclusive surface and curvature corrections, and that these can be found for arbitrary finite potentials without much trouble even in a non-separable case. (JFP)

17326 (COO-1764-187) THEORETICAL AND HIGH ENERGY PHYSICS PROGRAMS. Progress Report, September 1, 1972–August 31, 1973. (Minnesota Univ., Minneapolis (USA). Inst. of Tech.). 1073. Contract AT(11-1)1764. 32p. Dep. NTIS $3.75.

Research in nuclear physics and elementary particle physics is described. The nuclear research is all theoretical, but the high energy research is both theoretical and experimental. The report is organized according to this three-way division of the research activities. It is warned that some of the results presented are tentative and may be modified before publication. A list of publications is presented. (auth)

17327 (COO-3001-50) PADE APPROXIMANTS AND REALISTIC EFFECTIVE INTERACTIONS. Krenciglowa, E. M.; Kuo, T. T. S.; Osnes, E.; Giraud, B. (State Univ. of New York, Stony Brook (USA). Dept. of Physics; CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). 1973. Contract AT(11-1)-3001. 12p. Dep. NTIS $3.00.

The convergence of the J = 0, T = 1 effective interaction for sd-shell nuclei is studied in terms of separate summations of infinite subseries. It is suggested that first the subset of non-folded diagrams be separately summed to all orders and that the remaining, folded diagrams be grouped according to the number of folds and expressed in terms of the former sum of non-folded diagrams and its energy derivatives. The sum of non-folded diagrams is extrapolated from the three lowest orders using the Padé approximation, and encouraging results are obtained. (auth)

17328 (COO-3235-28) NEW METHOD FOR DETERMINING K-MATRIX ELEMENTS. Kouri, D. J.; Levin, F. S. (Brown Univ., Providence, R. I. (USA). Dept. of Physics). 1973. 7p. Dep. NTIS $3.00.

Formal solutions to the integral equation for the K operator are difficult to obtain because the principal value Green's function does not have a Lippmann-Schwinger iteration. A new Hermitian operator $\bar{K} = V + V[P/(E-H)]V$ is introduced and it is shown that its on-shell and half-off-shell partial wave matrix elements are equal to $\cos^2\delta_l$ times those of the usual K operator. From these the fully off-shell values of K can be determined. (auth)

17329 (LA-5443-C) LECTURES FROM THE LAMPF SUMMER SCHOOL ON THE THEORY OF PION–NUCLEUS SCATTERING, JULY 23–26, 1973. Gibbs, W. R.; Gibson, B. F. V (eds.). (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 249p. (CONF-730733-). Dep. NTIS $7.60.

From LAMPF summer school on the theory of pion-nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

Separate abstracts were prepared for the 22 lectures included. (JFP)

For abstracts of individual lectures see: 17012, 17119, 17138–17143, and 17330–17343.

17330 (LA-5443-C, pp 14-42) INTRODUCTORY REVIEW OF MULTIPLE-SCATTERING THEORY FOR PION–NUCLEUS SCATTERING. Eisenberg, J. M. (Univ. of Virginia, Charlottesville). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

The theory of π-nucleon and π-nucleus scattering at medium energies is reviewed. The derivation of the latter from knowledge of the former is performed in the framework of multiple scattering theory. To this end, the salient aspects of various multiple scattering theories are reviewed. (auth)

17331 (LA-5443-C, pp 43-55) CLASSICAL PION–NUCLEUS OPTICAL MODEL. Sternheim, M. M. (Univ. of Massachusetts, Amherst). Oct 1973.

In lectures from the LAMPF summer school.

A lecture is given on a review of Watson's derivation of the optical potential, with all the approximations clearly listed, several caveats and comments relating to the various approximations, the comparison of the Kisslinger and other models with experimental data, and the introduction to the newest and simplest successful form of the classical optical model, the effective radius model. (JFP)

17332 (LA-5443-C, pp 56-71) GENERALIZED OPTICAL MODEL IN THE (3,3) RESONANCE REGION. Schmit, C. (Institut de Physique Nucleaire, Orsay, France). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

The discussion covers a brief review of the multiple scattering theory, the effects of the off-shell extension of the pion–nucleon transition matrix, the convergence of the multiple scattering series, the introduction of a pion-bound nucleon transition operator which should give a better estimate of the 1st order optical potential, and the evaluation of the second-order of the optical potential. (JFP)

17333 (LA-5443-C, pp 72-86) PION–NUCLEUS SCATTERING ASSUMING A SEPARABLE MICROSCOPIC PION–NUCLEON INTERACTION. Walker, G. E. (Indiana Univ., Bloomington). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

The work of two groups is outlined, and their procedures are discussed and contrasted. Results and detailed predictions for elastic scattering obtained using both approaches are shown. (JFP)

17334 (LA-5443-C, pp 87-112) FIXED NUCLEON CALCULATIONS. Franco, V. (Brooklyn Coll.). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

Some recent investigations of eikonal expansions for two-body scattering, some multiple scattering approaches to scattering by composite systems (including the Glauber approximation), and some comparisons of different approximations are described. (auth)

17335 (LA-5443-C, pp 113-125) PION–NUCLEUS INTERACTIONS AT ZERO ENERGY. Ericson, T. E. O. (CERN, Geneva). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

The topics discussed are scale factors and observables in the mesic atom, a relation between complex energy shifts and scattering lengths, an anomaly in the pion–nucleus interaction, a theorem of multiple scattering theory, the repulsive s-wave interaction, the gradient potential, and the nuclear Lorentz effect. (JFP)

17336 (LA-5443-C, pp 126-134) PION PHASES IN NUCLEAR MATTER. Sawyer, R. F. (Univ. of California, Santa Barbara). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

The possibility of pion condensation is discussed. (JFP)

17337 (LA-5443-C, pp 135-153) PION-NUCLEUS REACTIONS. Rost, E. S. (Univ. of Colorado, Boulder). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

Inelastic scattering and charge-exchange reactions are discussed in the framework of a generalized optical model for the pion–nucleus system. Optical model wave functions are also used as distorted waves for the calculation of pion absorption and production processes. (auth)

17338 (LA-5443-C, pp 157-161) THEORY OF THE PION–NUCLEUS OPTICAL POTENTIAL WITH CROSSING. Cammarata, J. B.; Banerjee, M. K. (Univ. of Maryland, College Park). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

A theory of the π-nucleus optical potential is developed from the exact propagator of a pion in the presence of a nucleus. The crossed π-nucleus diagrams, absent in previous work, are shown to have a significant effect on the cross sections and the elastic scattering wave functions of low energy pions. (auth)

17339 (LA-5443-C, pp 162-171) PAULI BLOCKING IN PION–NUCLEUS SCATTERING IN THE 3,3 RESONANCE REGION. Eisenberg, J. M.; Weber, H. J. (Univ. of Virginia, Charlottesville). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

Chew–Low theory for pion scattering from nuclear matter is studied, taking into account the exclusion principle as it acts during the elementary pion–nucleon scattering as well as between successive πN scattering events. The Pauli blocking effectively reduces the strength of the 3,3 resonance in nuclei, changes the width and shifts the resonance energy upwards. A semi-classical treatment involving the index of refraction agrees with experiment. An optical model is constructed in the local density approximation. It depends on the forward πN scattering amplitude F(p,p) containing the internal effective pion momentum p in the nuclear medium derived from (the real part of) $p^2 = q^2 + 4\pi\rho F(p,p)$. Results are compared with recent data on pion scattering from ^{12}C, ^{16}O, and ^{40}Ca. Corrections due to the Fermi motion of nucleons and short-range correlations are discussed. (auth)

17340 (LA-5443-C, pp 186-189) CORRECTION BETWEEN THE OFF-SHELL CONTINUATION OF THE π–N SCATTERING AMPLITUDE AND THE IMPORTANCE OF NUCLEAR CORRELATIONS IN THE π–NUCLEUS OPTICAL POTENTIAL. Huefner, J. (Univ., Heidelberg). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

Since there was found to be a connection between the off-shell dependence and the presence of nuclear correlations, the connection is made somewhat more explicit by studying a simple model. The propagation of p-wave pions in nuclear matter is calculated. (JFP)

17341 (LA-5443-C, pp 193-198) INTERACTION OF PIONS WITH NUCLEAR MATTER. Johnson, M. Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

An attempt to calculate the interaction of a pion with uniform nuclear matter is discussed. The results are expected to be eventually applicable to the scattering of pions from nuclei. The theory is embodied in the dispersion relation $k^2 = \omega^2 - \mu^2 - 4\pi\rho f(k,\omega)$ where k is the (complex) wave-number of the pion of energy ω in matter of density ρ. Here f is the forward π-nucleon scattering amplitude (one assumes pure 3-3). The dispersion relation gives the solution to multiple-scattering theory under the assumption that the pion scatters from only one nucleon at a time. The amplitude $f(k,\omega)$ must be corrected for the presence of the nuclear medium, and two types of corrections will be discussed: the Pauli principle and the intermediate pion spectrum. Preliminary model calculation without the Pauli principle is presented; these indicate that the interaction is very attractive. No Kisslinger paradox arises. Experimental consequences will be mentioned. (auth)

17342 (LA-5443-C, pp 199-204) SCATTERING FROM A TWO-BODY TARGET: EXACT SOLUTION AND MULTIPLE SCATTER-

ING EXPANSION. Keister, B. D.; Koch, J. H. (Stanford Univ., CA). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

The general dependence of the elastic cross section on the various input parameters is examined. In particular the effects of overlapping scatterers and of changes in the nuclear wave function are investigated by comparing the exact solution to the results from a multiple scattering expansion. The basic assumption is that one can use closure on the nuclear target. (JFP)

17343 (LA-5443-C, pp 205-211) PAULI PRINCIPLE EFFECTS IN PION–NUCLEUS SCATTERING. Landau, R. H.; McMillian, M. (Univ. of British Columbia, Vancouver). Oct 1973.

From LAMPF summer school on the theory of pion–nucleus scattering; Los Alamos, New Mexico, USA (23 Jul 1973).

In lectures from the LAMPF summer school.

A quantitative estimate is made of the changes in π-nucleus scattering caused by incorporating the Pauli principle in a realistic optical potential. A modification is hypothesized in which the theoretical momentum space potential is simply multiplied by a Pauli suppression factor. Several forms for this factor are derived, combined with the optical potential, and the Schroedinger equation including these potentials is solved in momentum space. It is found that including the Pauli principle in a realistic optical potential can have significant albeit not drastic effects on calculated low and intermediate energy elastic scattering. The effects on differential cross sections are not readily noticeable although the approximately 15% changes in total cross sections can significantly improve the agreement with data. To reach these conclusions it is necessary to use a realistic model for nuclear scattering such as the optical model. Describing the nucleus by an unmodified Fermi gas model is not acceptable; some of its unphysical properties are removed when performing the calculation. (auth)

17344 (LYCEN-7361) SOME NUCLEAR MATTER CALCULATIONS WITH REALISTIC SEPARABLE NUCLEON–NUCLEON INTERACTIONS. Meunier, J. P.; Pigeon, J.; Nahabetian, R. (Lyon-1 Univ., 69 – Villeurbanne (France). Inst. de Physique Nucleaire). Sep 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The properties of nuclear matter (binding energy per particle, saturation density, compression modulus, defect parameter) were studied using the nonlocal separable interactions introduced by the Graz group. First order Brueckner theory and standard approximations were used. (auth)

17345 GENERATING FUNCTION AND INTEGRAL REPRESENTATION OF HERMITE POLYNOMIALS IN PHYSICAL PROBLEMS. Dvorak, S. (Tesla Roznov, Roznov pod Radhostem, Czech.). Czech. J. Phys.; 23: No. 12, 1281-1285(1973).

Using the generating function for Hermite polynomials H_n two integrals developed in computation of the binding energy of atomic nucleus were solved. Furthermore the probability distribution of the coordinate of quantum harmonic oscillator was derived with the aid of suitable integral representation of $H_n(x)$. Presented computations are simpler than the usually exploited recurrence equation technique. (auth)

17346 CONTRIBUTION TO THE NUCLEON–NUCLEUS OPTICAL POTENTIAL DUE TO A PICK-UP REACTION. Heiss, W. D. (Atomic Energy Board, Pretoria). Z. Phys.; 265: No. 1, 49-54 (Oct 1973).

In terms of diagrams the essential contribution to the self-energy, which is due to a pickup reaction, comes from the particle–particle ladder. This ladder contribution is calculated in an approximate way. An absorptive part of the optical potential is obtained which acts essentially as a surface absorptive. For each partial wave of the elastic channel it is a finite sum separable terms. A strong angular momentum dependence of the imaginary part of the potential at pickup threshold is found. This dependence is governed by the angular momentum of the bound orbitals, from which pickup occurs. (auth)

17347 GEOMETRY OF THE ISOMORPHIC MODEL OF THE CLOSED-SHELL NUCLEI. Anagnostatos, G. S. (North Carolina State Univ., Raleigh). Can. J. Phys.; 51: No. 9, 998-1004(1 May 1973).

The classical part of a new microscopic model of nuclear structure based on high spatial symmetry is proposed. The isomorphic model, as it is called, is a model of the closed-shell nuclei up to ^{208}Pb at the ground state. In brief, it assumes stable dynamic equilibrium of nucleons on spherical shells, which results in shells having average shapes represented by high symmetry polyhedra derived from one another, whose vertices represent average nucleon positions. Properties successfully examined by application of this classical part alone are nuclear shells and magic numbers, nuclear radii, nuclear density, and ground-state moments of inertia of rotating nuclei based on a closed-shell approximation. Through the presentation of this new model, it is desired above all to show that symmetry, used as the basis for a nuclear structure model, is highly successful just as in other areas of physics and chemistry. (auth)

17348 PENETRABILITY CALCULATIONS THROUGH A DOUBLE-HUMP BARRIER IN NUCLEAR FISSION. LeBoeuf, J. N.; Sharma, R. C. (Sir George Williams Univ., Montreal). Can. J. Phys.; 51: No. 4, 446-454(15 Feb 1973).

The penetrability through double-hump barrier in nuclear fission processes is calculated in the JWKB approximation based on Fröman's F-matrix formalism. Particular attention is paid to coinciding classical turning points where other methods break down. A qualitative discussion of results is also included. (auth)

17349 ANTISYMMETRIC BOSONS IN NUCLEAR STRUCTURE. Banville, M.; Simard, P. A. (Univ. of Sherbrooke, Quebec). Can. J. Phys.; 51: No. 1, 40-49(1 Jan 1973).

The concept of an ideal space of bosons and ideal particles is applied directly to systems of ordinary particles with a transcription of the particle into that ideal space that preserves both the Pauli principle and the transformation properties of the one- and two-body operators. Systems up to four particles are treated. (auth)

17350 COLLECTIVE STATES AND ELASTIC NUCLEON–NUCLEUS SCATTERING. Heiss, W. D. (Atomic Energy Board, Pretoria). Z. Phys.; 265: No. 1, 33-48(Oct 1973).

The connection between singularities of the elastic scattering amplitude and the self-energy which are due to collective excitations is discussed. It is shown that a pole of the self-energy will normally lead to a close-lying resonance pole of the scattering amplitude. The significance of this fact for a phenomenological optical potential is pointed out. The Weinberg method is proposed for the calculation of the simplest collective states, the particle-hole and particle–particle states. This method makes the consistent incorporation of such collective states into the description of scattering feasible. Its practical application has been tested by a simple model, the results of which are presented. (auth)

17351 DIFFRACTION MODEL STUDY OF TWO-NUCLEON TRANSFER REACTIONS. Dobes, J. (Inst. of Nuclear Physics, Rez, Czech.). Czech. J. Phys.; 23: No. 12, 1286-1297(1973).

A simple diffraction model using sharp cut-off in the angular momentum space is adopted for the two-nucleon transfer reactions. Some (p,t) reactions on 1p shell nuclei are analyzed with satisfactory results. The finite range calculations are performable in the model, and they are compared with the results of approximate theories. The angular distributions in various theories differ little, and the ratios of absolute magnitudes remain relatively constant. (auth)

17352 DECAY FORMULA AND FISSION BARRIER. Malik, F. B. (Univ., Neuchatel, Switzerland); Sabatier, P. C. Helv. Phys. Acta; 46: No. 3, 304-315(1973).

For any theory of fission, which construes the last step as a one-dimensional tunnelling process through a potential barrier, it is shown that the observed pre-neutron emission kinetic energies are inconsistent with the Bohr–Wheeler–Strutinski barrier used in computing the spontaneous fission half-lives. As regards these data, it is established that the significant feature of any model which attempts to describe the last stage of fission as a single channel tunneling phenomenon is the presence of a potential hole whose minimum is lower than the observed kinetic energy. Only such a hole can contain a resonant state decaying through the last stage of the barrier with appropriate kinetic energies. Besides, the observed half-lives indicate that this last stage of the barrier is likely to be thinner than the one usually used. Also an exact expression relating the half-life of a decay process through a barrier to the phase shift of the scattering by the associated potential is formulated. (auth)

17353 PADE APPROXIMANTS AND REALISTIC EFFECTIVE INTERACTIONS. Krenciglowa, E. M. (State Univ. of New York, Stony Brook); Kuo, T. T. S.; Osnes, E.; Giraud, B. Phys. Lett.; 47B: No. 4, 322-326(26 Nov 1973).

The convergence of the J = 0, T = 1 effective interaction for sd-shell nuclei is studied in terms of separate summations of infinite subseries. It is suggested that first the subset of nonfolded diagrams be separately summed to all orders and that the remaining, folded diagrams be grouped according to the number of folds and expressed in terms of the former sum of nonfolded diagrams and its energy derivatives. The sum of nonfolded diagrams is extrapolated from the lowest three orders using the Padé approximation, and encouraging results are obtained. (auth)

17354 PHASE SHIFT TECHNIQUE FOR THE DIRAC EQUATION AND THE CALCULATION OF THE CRITICAL NUCLEAR

CHARGE. Marinov, M. S.; Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2141-2154(Dec 1973). (In Russian).

A simple method for solving the Dirac and Schroedinger equations with an arbitrary potential V(r) is developed which is convenient for qualitative analysis of the problem and for numerical calculations. The idea of the method is that the equation under consideration is replaced by a first order nonlinear equation for the phase function $\theta(r)$. Application of the method to the problem of appearance of a bound level and its application for calculation of the critical charge Z_c are considered. The effect of screening of the nuclear Coulomb field by the electron shell on Z_c is estimated. Variational calculations of Z_c for a system of colliding nuclei (relativistic two-center problem) are performed. Other applications of the phase equation are briefly discussed, viz. determination of the potential barrier reflection coefficient and pair production in a varying electric field. (auth)

17355 EFFECT OF TIME-REVERSAL NONINVARIANCE ON NUCLEAR γ-DECAY OBSERVABLES. Steyert, W. A. (Los Alamos Scientific Lab., NM); Krane, K. S. Phys. Lett.; 47B: No. 4, 294-296(26 Nov 1973).

Some criteria are proposed which should allow greatly increased sensitivity of nuclear γ-decay studies to possible time reversal violation. Hindrance can be a more significant criterion in choosing nuclei for investigation than that previously employed-namely multipole mixing ratios near unity. (auth)

17356 COMPARISON OF THE EXPERIMENTAL AND THEORETICAL SHAPES OF THE DOPPLER γ LINES BY MEANS OF THE MAXIMUM-LIKELIHOOD METHOD. Erokhina, K. I.; Zhirgulevichyus, R. K.; Lemberg, I. Kh.; Pasternak, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1590-1594(Aug 1973). (In Russian).

For evaluation of the parameters of the theoretical forms of the γ lines on the basis of its comparison with experimental data, the method of maximum probability was used. The comparison procedure made it possible with a minimum number of iterations to superpose automatically the theoretical form of the lines with the experimental and to determine the lifetimes of the corresponding levels. (tr-auth)

17357 DETERMINATION OF THE EFFICIENCY FOR DETECTION OF γ QUANTA AT ENERGY PEAKS BY MEANS OF NUCLIDES WITH COMPLEX DECAY SCHEMES IN CONDITIONS OF SIMILAR GEOMETRY. Andreev, D. S.; Erokhina, K. I.; Zvonov, V. S.; Lemberg, I. Kh. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1609-1612(Aug 1973). (In Russian).

A method was proposed for the consideration of corrections connected with the presence of cascade transitions during the determination of the efficiency of the registration of γ quanta at total energy peaks by means of nuclides with complex decay schemes. Using as example the calibration with ^{152}Eu of the efficiency of coaxial Ge(Li) detectors with 16.5 cm^3 volume in conditions of similar geometry the errors arising with neglect of the effect of cascade transitions were evaluated. (tr-auth)

17358 ASYMPTOTIC VALUES OF THE FREQUENCY OF MONOPOLE AND QUADRUPOLE OSCILLATIONS. Filippov, G. F.; Steshenko, A. I.; Ovcharenko, V. I. (Inst. of Theoretical Physics, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1613-1616(Aug 1973). (In Russian).

Basis functions of the rotation group representation in the (A-1)-dimensional space was used to construct test functions of the variational calculation of the binding energy and spectra of the collective excitation of magic nuclei. Asymptotic expressions were found for the frequency of the monopole and quadrupole oscillations of the nucleus with a large number of nucleons. (tr-auth)

17359 MULTINUCLEON CORRELATIONS AND EFFECTIVE FORCES IN NUCLEI. Dzhibuti, R. I. (Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1562-1574 (Aug 1973). (In Russian).

A survey is given of the results from the application of methods developed in the theory of small-nucleon systems for investigation of the effects of multinucleon correlations in nuclei. 54 references. (tr-auth)

17360 CONVERSION OF CONTINUOUS INSTRUMENTAL β SPECTRA INTO THE REAL SPECTRA. Saulit, V. R. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1671-1676(Aug 1973). (In Russian).

A method was developed for the processing of experimental data by making it possible to convert continuous β spectra into the real spectra. The method is based on the solution of integral equations connecting the distribution functions of the instrumental and real spectra. (tr-auth)

17361 EFFECTS OF NONCONSERVATION OF PARITY IN ELECTROMAGNETIC TRANSITIONS OF NUCLEI WITH CONSIDERATION OF HIGHER APPROXIMATIONS. Borisoglebskii, L. A.; Kuzhir, P. G. (Belorussian State Univ., Minsk). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1761-1763(Aug 1973). (In Russian).

An attempt is made to show how the consideration of the higher approximations can affect the size of the degree of circular polarization during de-excitation of nuclei with both single γ quantum and with $\gamma-\gamma$ cascades. It was shown that the consideration of the higher approximations during calculation of the circular polarization for low transition energies gives a significantly more precise value and this leads to a very exact representation of the character of the weak internucleon force. (JSR)

17362 EFFECT OF PENETRATION IN THE THEORY OF INTERNAL CONVERSION WITH CONSIDERATION OF THE SHAPE OF THE CHARGE DISTRIBUTION IN THE NUCLEUS. Listengarten, M. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1731-1738(Aug 1973). (In Russian).

A theoretical study was made of the effect of the form of the charge distribution in the nucleus on the size of effects connected with the penetration of electrons within the nucleus. The scale factor was derived. The effect of the form of the charge distribution on the probability of EO conversion was analyzed. Its effect on the size of the electron parameters used for the analysis of anomalies in the electron conversion coefficient was determined. (JSR)

17363 INTENSITY OF THE COULOMB MIXING BETWEEN $T = T_0$ ISOBARIC ANALOG STATES AND $T = T_0 - 1$ MONOPOLE EXCITATIONS. Aleshin, V. P. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1775-1778(Aug 1973). (In Russian).

By use of the formalism of the Clebsch-Gordan coefficients the particle-hole states having a given isospin were constructed for nuclei with $N > Z$. The intensity of the Coulomb mixing of the analog states $T = T_0$ with high lying monopole excitations $T = T_0 - 1$ was calculated as a function of Z. (tr-auth)

17364 ELASTIC SCATTERING OF ELECTRONS WITH ANOMALOUS MAGNETIC MOMENT ON NUCLEI WITH MULTIPOLE MOMENTS. Kerimov, B. K.; Aruri, T. R.; Safin, M. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1768-1774(Aug 1973). (In Russian).

In the one-photon approximation an expression was obtained for the differential cross section of the elastic scattering of fast electrons on nuclei with arbitrary spins with consideration of the simultaneous correlation of the helicity between the initial and final electrons and the interaction of the anomalous magnetic moment of the electron with the electromagnetic multipole moment of the target nucleus. It was shown that consideration of the anomalous magnetic moment of the electron leads to the appearance of scattering channels with change of the helicity of the high energy electrons. (tr-auth)

17365 EFFECT OF THE BLURRING OF THE NUCLEAR BOUNDARIES AND COULOMB EXCITATION IN THE DIFFRACTION MODEL OF DEUTERON STRIPPING. Berezhnoi, Yu. A.; Evlanov, M. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1745-1749(Aug 1973). (In Russian).

Expressions were derived for the differential cross section of (d,p) reactions within the framework of the diffraction model of deuteron stripping. Calculations of differential cross sections with these expressions showed that consideration of the blurring of the nuclear boundaries leads to an increase of the stripping cross section. The stripping cross section also increases with increase of the mass number of the target nucleus. The diffraction model agrees with experimental data in the area of medium and heavy nuclei. (JSR)

17366 POLARIZATION EFFECTS DURING ELASTIC SCATTERING OF MEDIUM-ENERGY DEUTERONS. Vysotskii, G. L.; Soznik, A. P.; Chegoryan, M. A. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1742-1744(Aug 1973). (In Russian).

Simple analytical expressions describing the cross section and spin-tensors of polarized deuterons were obtained in the saddle-point model by the method of steepest descents. (tr-auth)

17367 CLUSTER REPRESENTATIONS AND ROTATIONAL STATES. Kramer, P. (Univ., Tuebingen, Ger.); Wildermuth, K.; Beam, J. Particles Nucl.; 5: No. 5-6, 145-176(1973).

In continuation of a previous paper where the structure of rotational levels of even-even nuclei was discussed, the general structure of such levels in odd-even and odd-odd nuclei in the framework of a unified nuclear theory was investigated. Furthermore the relations between the different models for the description of nuclear rotational states are considered. (auth)

17368 PENETRABILITY THROUGH A DOUBLE-HUMP BARRIER OF STRUTINSKY TYPE. Leboeuf, J. N.; Sharma, R. C. (Sir George Williams Univ., Montreal). Can. J. Phys.; 51: No. 11, 1148-1154(1 Jun 1973).

An expression is derived for the penetrability through Strutinsky's fission barrier by a method similar to Cramer and Nix's. Both incident and reflected waves are considered in the first well to include the prefission state of the nucleus. An approximation is introduced to obtain the amplitude of the wave transmitted out of the second hump of the barrier. The penetrability is expressed in terms of Weber's parabolic-cylinder functions. (auth)

17369 PENETRABILITY THROUGH DOUBLE-HUMP BARRIERS IN NUCLEAR FISSION. Leboeuf, J. N.; Sharma, R. C. (Sir George Williams Univ., Montreal). Can. J. Phys.; 51: No. 18, 2023-2024(15 Sep 1973).

An attempt is made to refine the JWKB approxmated expression for penetrability through a double-hump fission barrier when classical turning points are closely situated. (auth)

17370 ASYMMETRIC NUCLEAR MATTER IN SECOND-ORDER PERTURBATION THEORY. Cote, J.; Rouben, B.; Pearson, J. M. (Univ. of Montreal). Can. J. Phys.; 51: No. 15, 1619-1626(1 Aug 1973).

The second-order perturbation theory of nuclear matter is extended to the case where the neutron and proton densities are different. The symmetry coefficients given by the force of Tabakin and that of de Tourreil and Sprung are computed in second order. (auth)

17371 STIMULATED LINE NARROWING AND THE MOESSBAUER EFFECT ON LONG-LIVED ISOMERS. Namiot, V. A. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 216-219(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 369-373(20 Sep 1973).

The possibility is considered of suppressing the inhomogeneous shift of the Mossbauer line of a long-lived nuclear isomer by placing the crystal in an external periodically-varying electromagnetic field with a specially chosen temporal waveform of the signal. (auth)

17372 POSSIBILITY OF USING THE LG FT VALUE FOR ANALYSIS OF THE EXCITED STATES OF SPHERICAL NUCLEI. Kiselev, B. G. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 8, 1717-1720(Aug 1973). (In Russian).

Attempts were made to determine the limitations of applicability of a method using the reduced β transition probability for the analysis of the structure of the excited states of spherical nuclei on the basis of available experimental data on the values of lg ft for β transitions which can be considered as transitions between members of the spin–orbit doublet. The method can not be used for nuclei with neutron number from 30 to 50, but can be used with nuclei with $90 \leq A \leq 120$ with β transitions of the $p_{\frac{1}{2}} \rightleftharpoons p_{\frac{3}{2}}$ type and nuclei with $100 \leq A \leq 140$ with β transitions of the $d_{\frac{3}{2}} \rightleftharpoons d_{\frac{5}{2}}$ type. (3 figures) (JSR)

17373 LORENTZ–LORENZ EFFECT IN PION–NUCLEUS INTERACTIONS. Eisenberg, J. M. (Los Alamos Scientific Lab., NM); Huefner, J.; Moniz, E. J. Phys. Lett.; 47B: No. 5, 381-384(10 Dec 1973).

The Lorentz–Lorenz effect in pion-nucleus interactions is derived from the Watson expansion of the optical potential. The use of a realistic, finite range πN interaction significantly reduces its importance for nuclear short-range correlations in pionic atoms. (auth)

17374 STATIC MOMENTS OF EVEN–EVEN SPHERICAL NUCLEI IN EXCITED STATES. Simonov, A. J. (Inst. of Physical Chemistry, Moscow); Troitskii, M. A. Phys. Lett.; 47B: No. 5, 405-407(10 Dec 1973).

A microscopic approach is developed for calculation of static moments of even-even spherical nuclei in excited states. (auth)

17375 THOMAS–FERMI APPROXIMATION AND THE IMAGINARY PART OF THE OPTICAL POTENTIAL. Sinha, B.; Duggan, F. (King's Coll., London). Phys. Lett.; 47B: No. 5, 389-393(10 Dec 1973).

The imaginary part of the optical potential is calculated using the Kuo–Brown effective interaction and assuming that the absorption arises entirely from the forward scattering amplitude. It is concluded that the Thomas–Fermi approximation used to describe the nucleus is accurate up to the point the density drops off by eighty-five percent beyond which point the potential itself becomes negligibly small. An analytical expression is derived for taking into account approximately the contribution of the non-zero momentum transfers in the scattering amplitude. (auth)

17376 RELATIVISTIC CORRECTIONS TO NUCLEAR MATRIX ELEMENTS IN MIRROR β-DECAYS. Mukhopadhyay, N. C.; Miller, L. D. (Univ. of Maryland, College Park). Phys. Lett.; 47B: No. 5, 415-418(10 Dec 1973).

Relativistic corrections to nuclear matrix elements in mirror β-decays are discussed in the context of a relativistic single-particle model (RSPM). Corrections to the Dirac magnetic moments are shown to play an important role in the determination of (g_A/g_V) in nuclei. (auth)

17377 DEPARTURES FROM THE HAUSER–FESHBACH THEORY DUE TO THE LEVEL–LEVEL CORRELATIONS IN DEFORMED NUCLEI. Sevgen, A. (Univ., Freiburg i. B.). Nucl. Phys.; A218: No. 3, 542-558(1974).

A microscopic dynamical model is used for the inelastic scattering of nucleons by deformed nuclei and the fluctuation cross sections are calculated. The case of weak absorption in all channels is considered so that the number of statistical assumptions is minimized. The results are compared with the Hauser-Feshbach expressions as regards the magnitude and structure. The partial width amplitudes calculated from the model are correlated, the simplest type of level-level correlations being due to the similar-channels effect (SCE). When the correlations are due to SCE alone, the following two results are obtained. The fluctuation cross sections are increased over the Hauser-Feshbach estimates, for $\Gamma \ll D$ and $\Gamma \gg D$, by a factor κ if the entrance and exit channels are similar. The numerical value of κ is found to be 3 for a special case and in the general case it is conjectured to lie between the limits 1 and 3. The fluctuation cross sections $\sigma^{fl}_{cc'}$ and $\sigma^{fl}_{cc''}$ exhibit correlated fluctuations if the exit channels c' and c'' are similar. The fluctuation cross sections in the cases "SCE + direct channel-channel coupling" and "SCE + intermediate structure" are also investigated. In all cases studied direct reaction cross sections do not vanish and the channelwise factorization assumption of the Hauser-Feshbach theory fails. (auth)

17378 PERTURBATION THEORY FOR PROJECTED STATES IN THE PAIRING FORCE MODEL. Atalay, B.; Brink, D. M.; Mann, A. (Oxford Univ.). Nucl. Phys.; A218: No. 3, 461-469 (1974).

The perturbation theory for projected states is applied to the two-level pairing force model. Both approximate and exact forms of number projection are considered. The results are compared with the exact ones and with ordinary perturbation theory based on BCS wave functions without projection. (auth)

17379 DEPENDENCE OF THE Λ-NUCLEUS INTERACTION POTENTIAL ON THE MOMENTUM AND ON THE HYPERNUCLEUS BINDING ENERGY. Filimonov, V. A. (Tomsk Polytechnical Inst., USSR). Yadern. Fiz.; 18: No. 6, 1173-1183(Dec 1973). (In Russian).

Interaction of the Λ hyperon with nucleus is approximated by the Woods–Saxon potential, depending on the momentum. In the nonhermitian approximation the s-wave motion in such a potential is equivalent to the motion in the Woods–Saxon potential with an energy-dependent depth and a modified width of the well. Various analytical representations of the wave function and of the equations, determining the energy eigenvalues, are found for this case. Analysis of binding energies of hypernuclei, based on the considered model (with hermitian and nonhermitian Hamiltonians), indicates an existence of strong dependence of the Λ-nucleus potential on the Λ momentum. Estimates are obtained for the effective mass and the potential energy of Λ hyperon inside the nuclear matter: $M_\Lambda^* = (0.49 \pm 0.05)\, M_\Lambda$, $D_\Lambda = 36.5 \pm 1.5$ MeV. (auth)

17380 SUM RULES IN THE ELECTRON SCATTERING BY NUCLEI. Efros, V. D. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 18: No. 6, 1184-1202(Dec 1973). (In Russian).

The sum rules for the electron scattering by nuclei are formulated. It is shown that in the single-particle approximation for the nuclear current some of the sum rules are model-independent being expressed through the electron elastic form factors. These sum rules are attractive for the experimental investigation of the contribution of the nonsingle-particle current. It is also shown how the electron scattering data can be used to yield the nuclear Coulomb energy. (auth)

17381 EFFECT OF THE NUCLEAR SHELL STRUCTURE ON THE POLARIZATION OF ELASTICALLY SCATTERED NEUTRONS. Ivanyuk, F. A.; Konstantinov, B. D. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 18: No. 6, 1203-1208(Dec 1973). (In Russian).

Strutinsky's shell-correction method is used to study the effect of shell oscillations of the nucleon density inside a nucleus on the neutron polarization in elastic scattering. The polarization is

calculated numerically for a number of the spherical nucleus isotopes. It is shown that the polarization is essentially affected by the density shell oscillations only at the energies of the scattered neutrons corresponding to the energies of one-body resonances. (auth)

17382 TRANSFORMATION COEFFICIENTS IN HYPERSPHERICAL APPROACH TO THE PROBLEM OF FOUR BODIES WITH NONEQUAL MASSES. Dzhibuti, R. I.; Tomchinskii, V. Yu.; Shubitidze, N. I. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz.; 18: No. 6, 1164-1172(Dec 1973). (In Russian).

Raynal–Revai theory for the hyperspherical basis is generalized to the case of four bodies with non-equal masses. The analytical expressions are obtained for the coefficients of transformation from one basis to another. These coefficients simplify the calculation technique in the K-harmonics method for four bodies and can be used, in particular, in the cluster model of light nuclei. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

Confinement and Heating

Refer also to abstracts 17407, 17409, 17438, and 17447.

17383 (COO-2288-4) ABSORPTION OF ELECTROMAGNETIC WAVES NEAR THE CRITICAL DENSITY. Annual Report, 1 December 1972–30 November 1973. Daiber, J. W.; Rehm, R. G.; Thompson, H. M. (Calspan Corp., Buffalo, N. Y. (USA)). 1973. Contract AT(11-1)-2288. 30p. Dep. NTIS $3.50.

The program is an experimental study of the interaction of high-intensity ruby laser radiation with hydrogen gas in a free-jet. In these experiments, both laser intensity and the plasma frequency can be varied. By monitoring several parameters, including incident and reflected power, x-ray emission and the kinematics of plasma growth, the existence of an anomalous threshold for coupling radiation into plasma energy should be determinable. A discussion of the status of the Calspan experiment and of the status of other anomalous coupling studies at laser frequencies is presented. (auth)

17384 (DNA-3175-F) THEORETICAL STUDY OF NON-LTE PROCESSES IN LASER-HEATED PLASMAS. Final Report, 15 June 1972–14 June 1973. Tamor, S. (Science Applications, Inc., La Jolla, Calif. (USA)). Oct 1973. vp. NTIS.

The development of a code for calculating the non-LTE kinetics of the excitation and ionization of a laser-heated plasma, and prediction of the emitted x-ray spectrum is described. This code is intended to be used for exploratory studies in which x-ray conversion efficiencies for various densities, compositions, temperature profiles, etc., are calculated. To carry out such computations, rate coefficients for all possible transitions must be available. A simple method of calculating these rates is derived. Since numerous runs involving a wide range of parameter choices is envisaged it is desired that the basic time step in the integration be very large. The resulting problem of stiffness of the rate equations and methods of overcoming it are discussed. Preliminary results for a neon plasma are presented. (auth)

17385 (EUR-CEA-FC-678(Pt. 2)) ANNUAL PROGRESS REPORT OF THE GRENOBLE RESEARCH GROUP, JANUARY 1 TO DECEMBER 31, 1972. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee). 1972. 114p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.

The general activities of the General Ion Service during 1972 are presented: research on hot electron plasmas produced and heated by electron cyclotron resonance; construction of toroidal machines (PETULA and WEGA) for the study of hf heating. Research on closed configurations concerned, principally, hf heating, energy balance equations, the effect of heating on the diffusion of particles as well as the effect of the form of the straight section of a tokamak-type discharge on the MHD stability. The following hot electron machines were studied: the 25kW CIRCE, and whole and half-bottle configurations. (FR)

17386 (UCB-34-P-128-22) SECOND SEMIANNUAL PROGRESS REPORT OF 1972 ON PLASMA RESEARCH, 1 JULY–31 DECEMBER 1972. (California Univ., Berkeley (USA). Electronics Research Lab.). 1972. Contract AT(04-3)-34. 44p. Dep. NTIS $4.25.

Plasma research is concerned primarily with the problems of creating, containing, and heating high-temperature plasmas. The research involves studying the physical and electromagnetic properties, the stability, and the radiation of these plasmas. Low-temperature plasmas are used as analogues to study the stability of high temperature plasmas. The high-temperature plasma research facility consists of a 250,000-joule capacitor energy-storage bank and related control system. The bank serves either of two magnetic-mirror compression experiments, BME-I and BME-II, which require peak magnetic fields in excess of 50,000 gauss. Currently, a high current relativistic electron beam experiment is planned for BME-I, while BME-II is being used in the study of electron cyclotron resonance heating and modulated electron beam heating of a contact ionization lithium plasma. The low-temperature plasma facilities are two alkali-metal vapor plasma devices. One of these devices has been used to study an impurity mixing instability, and the other is being used to study the principle of multiple mirror confinement of plasmas. Complementary to the experiments are a wide range of theoretical studies. Computer experiments in one, two, and three dimensions are being used to study both many-body systems and nonlinear systems as initial value problems; this form of simulation has produced a number of results not obtainable analytically and prior to experimental observation. Other theoretical work has included electron cyclotron resonance heating, the dynamics of single particles in toroidal fields or mirrors, and the solution of linear dispersion relations. (auth)

17387 (UCI-34-P-207-X-1) STUDY OF PLASMA HEATING BY INTENSE RELATIVISTIC ELECTRON BEAMS. Progress Report, March 31, 1973–September 30, 1973. Rostoker, N.; Rynn, N. (California Univ., Irvine (USA)). Oct 1973. Contract AT(04-3)-34. 118p. Dep. NTIS $8.00.

Plasma heating was studied in a cusp-injection magnetic trap where both an intense rotating relativistic electron beam and a plasma are confined. A mirror system is selected because many exploratory experiments have already established that intense relativistic beams can be trapped and various mechanisms for energy transfer have been discussed in the literature. An analysis was carried out which shows that the decay of the return current in the proposed geometry produces a very strong trapping mechanism similar to the resistive rings employed by Christofilos. If the resistive medium is the plasma through which the beam passes, the problems inherent in external resistive rings are absent. The objective of the program is to study the various heating mechanisms in a situation where the beam is confined in order to determine which mechanisms are important and are consistent with confinement. Calculations for the decay of the azimuthal return current show that ions will be primarily heated, which is to be contrasted with earlier calculations of decay of the current which mainly heats electrons. A detailed design of the experiment was carried out including a cost analysis. In addition, some questions concerning stability of a rotating annular beam were resolved. (auth)

17388 (UCLA-34-P-157-X-7) JOINT EXPERIMENTAL–THEORETICAL PROGRAM IN PLASMA HEATING AND CONTROL. [Progress Report, 1973]. (California Univ., Los Angeles (USA)). 1973. Contract AT(11-1)-34. 58p. Dep. NTIS $5.00.

Research during this report period is reported for the following areas: (1) theoretical studies, (2) experiments on plasma properties and heating, (3) laser-plasma studies, and (4) computer simulation. (MOW)

17389 MICROWAVE HEATING OF ELECTRONS OF A DENSE PLASMA COLUMN AT FREQUENCIES HIGHER THAN ELECTRON CYCLOTRON FREQUENCY. II. Excited Electron Cyclotron Harmonic Waves and Their Resonant Wave–Wave Interaction. Datlov, J. (Inst. of Plasma Physics, Prague); Klima, R.; Kryska, L.; Budnikov, V. N.; Scherbinin, O. N. Czech. J. Phys.; 23: No. 12, 1315-1332(1973).

In the overdense collisionless plasma column inserted through the narrow sides of a rectangular waveguide, the excited electron cyclotron harmonic waves (CHWs) are studied by means of two movable probes and a phase interferometer in the range of parameters of $2 > \omega/\omega_{ce} > 1$; $0.5 < (\omega_{pe}/\omega)^2 < 15$. Two kinds of CH waves were found in the dipole mode: (a) stable backward CH waves with the phase velocity in the direction from the axis to the periphery; and (b) unstable backward CH waves with the phase velocity in the opposite direction. From the correlation measurements and amplitude distribution of the CH waves at the applied frequency and its second harmonic frequency it was found that in the range of $2 > \omega/\omega_{ce} > 1.5$, efficient nonlinear resonant interaction of CH waves takes place. The position of the loci of resonant interaction inside the plasma column was found both experimentally and by a simple new graphical procedure for the resonant conditions of the form $\omega_2 = 2\omega_1$; $k_2 = 2|k_1|$. In the absence of this condition, no effective generation of the second harmonic frequency has been found. The resonant interaction of CHWs at $\omega/\omega_{ce} = 1.85$ is the cause of self-trapping of CH waves between the zones of resonant interaction in radial direction and of the anomalous heating rate of the electrons. (auth)

17390 PHYSICAL PICTURE OF TRANSIT-TIME MAGNETIC PUMPING. Cattanei, G. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 13: No. 6, 839-842(Dec 1973).

The existing theories of transit-time magnetic pumping are based either on the motion of the guiding center or on the dielectric properties of the plasma and give the ion heating rate and the rf power absorbed by the plasma, respectively. It is shown here that the two theories produce identical results if the flux of ion kinetic energy within the plasma is taken into account and that this flux is not accompanied by any mass transport. (auth)

17391 ENERGY BALANCE FOR A PULSED D–T REACTOR. Dolan, T. J.; Keller, K. F. (Univ. of Missouri, Rolla). Nucl. Fusion; 13: No. 6, 875-879(Dec 1973).

The energy flow per pulse of a D–T reactor is considered, including effects of radial and temporal variations of plasma density and temperature. The overall "efficiency" of the cycle will probably be less than 20% because of the inefficiency of coupling electrical energy into plasma thermal energy. This low overall efficiency and the spatial and temporal effects lead to required products of density and confirement time that are significantly higher than those obtained ignoring these effects. (auth)

17392 PRESSURE CONSTRAINTS AND LIMITATIONS IN GAS-BLANKET SYSTEMS. Lehnert, B. (Royal Inst. of Tech., Stockholm). Nucl. Fusion; 13: No. 6, 958-959(Dec 1973).

Balance equations of the partially ionized boundary layer of a dense plasma surrounded by a neutral gas blanket are discussed. The plasma-blanket pressure ratio and pressure and density limitations are described. (MOW)

Diagnostics

17393 (ORO-3393-10) APPLICATIONS OF LIGHT SCATTERING TO PLASMA DIAGNOSTICS. Progress Report, April 1972–March 1973. (Maryland Univ., College Park (USA)). 1973. Contract AT(40-1)-3393. 5p. Dep. NTIS $3.00.

Results are described on resonant laser scattering and the spectroscopic and probe study of ion dynamics and heating in a theta pinch. No new results can be reported on the vacuum spark plasma (auth)

17394 ION TEMPERATURES IN ORMAK FROM DOPPLER BROADENING. McNally, J. R. Jr.; Neidigh, R. V. (Oak Ridge National Lab., TN). Nucl. Fusion; 13: No. 6, 919-923(Dec 1973).

Rapid-scanning spectrometric techniques have permitted the determination of ion temperatures in ORMAK as a function of time during the discharge pulse for ORMAK plasma currents up to 180 kA. Emission spectra of hydrogen atoms are Doppler-broadened in the line wings, characteristic of the initial proton motions prior to charge exchange, and give ion "temperatures" generally less than kT_+~300 eV. Impurity spectra of C III and O V, as well as the spectra of He II in helium discharges, lead to somewhat higher ion temperatures ranging up to a maximum of kT_+~700 eV. (auth)

17395 CERTAIN LIMITATIONS OF THE SPECTRAL-LINE REVERSAL METHOD. Preis, J. (Inst. of Thermomechanics, Prague). Acta Tech. CSAV; 17: No. 6, 695-701(1972). (In German).

The application of the spectrum-line reversal method in measuring the temperature of a nonisothermic low temperature plasma is discussed and the limitations are given. (auth)

Kinetics (General)

Refer also to abstract 16480.

17396 (NP-19928) LONGITUDINAL THERMAL CONDUCTIVITY INFLUENCE ON THE OHMIC PLASMA HEATING IN "TUMAN-1". Kaganskii, M. G.; Kalmykov, S. G.; Shakhovets, K. G. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 22p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

"Tuman-1" is a toroidal device with inhomogeneous longitudinal magnetic fields. A significant longitudinal temperature gradient has been discovered for 10^{14} to 10^{15} cm^{-3} plasma density and 5 to 30 eV electron temperature. The energy balance equation was analyzed taking into account the longitudinal thermal conductivity. Electron temperature dependence on the discharge parameters was obtained. The comparison of the calculations with temperature measurements having been made according to the electric conductivity has shown that the electron longitudinal thermal conductivity coefficients are close to classical value. The latter is determined by Coulomb pair collisions. The comparison is good if the directed electron velocity does not exceed the ion sound. (auth)

17397 ACCELERATION OF PLASMA CLUSTERS IN THE ACCELERATOR WITH EXTERNAL MAGNETIC FIELD. Kalivoda, L.; Rosenkranz, J. (Technical Univ., Prague). Czech. J. Phys.; 23: No. 12, 1305-1314(1973).

A theoretical model of the plasma cluster movement in an external magnetic field is described. The solutions made on a computer show the essential influence of the collision processes on the utilization of the magnetic field energy for the accelerating process. (auth)

17398 DEVIATIONS FROM THERMODYNAMIC EQUILIBRIUM DURING RECOMBINATION OF DISPERSING PLASMA. Gudzenko, L. I.; Syts'ko, Yu. I.; Filippov, S. S.; Yakovlenko, S. I. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 3-10(1973). (In Russian).

The relaxation of a dense low-temperature plasma during cooling of the electrons on heavy particles and during dispersion in a vacuum of the plasma bunch was examined. The population kinetics in the limiting case of free discharge and radiation capture were analyzed. The results of the numerical solution of the self-consistent (with respect to temperature and free electron concentration) problem on the relaxation of atomic hydrogen plasma were reported. (tr-auth)

17399 CONDITIONS OF BREAKDOWN LAYERS ADJACENT TO THE ELECTRODE IN AN IONIZED GAS FLOW. Lyubimov, G. A. Zh. Prikl. Mekh. Tekh. Fiz.; No. 3, 16-23(1973). (In Russian).

The critical voltage (or current) at which the transition of the discharge in ionized gas flow from the distributed discharge to arc discharge occurs varies within very wide limits. The conditions which the discharge parameters satisfy at the moment of the transition from distributed discharge to arc discharge were formulated on the basis of an analysis of test data. (tr-auth)

Kinetics (Experimental)

17400 (NP-19922) REGIONS OF THE SUPER-HIGH-FREQUENCY DISCHARGE IN DIFFERENT GASES FOR MAGNETIC FIELDS GREATER THAN THE CYCLOTRON FREQUENCY. Arkhipenko, V. I.; Budnikov, V. N. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 9p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Experimental data are presented on the regions of shf discharge for $\omega < \omega_{he}$, $\omega < \omega_p$ in argon, neon, and hydrogen. Discharge parameters are the following: the neutral-gas pressure is 10^{-2} mm Hg, charged-particle density of $n = 10^{11}$ to 10^{12} cm^{-3}, operating frequency is 2370 Mc, and magnetic field up to 4000 Oe. It was found that, for more light gases, the discharge exists in the region of bigger values of the parameters ω_p^2/ω^2 and ω_{he}^2/ω^2. (auth)

17401 LOCATION OF FAST DEUTERONS IN A PLASMA FOCUS. Belyaeva, I. F.; Filippov, N. V. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 13: No. 6, 881-882(Dec 1973).

It is found that the pattern of plasma changes in its structure when hard x rays are emitted from a plasma focus and that the sources of the hard x rays and the fast accelerated deuterons are located in the same region. It is shown that the character of the deuteron spectrum is directly related to the pattern of the plasma focus. (auth)

Kinetics (Theoretical)

Refer also to abstract 16854.

17402 (MATT-969) RADIAL PROFILE OF PLASMA RESISTIVITY DETERMINED FROM ac IMPEDANCE MEASUREMENTS IN THE ST TOKAMAK. Dellis, A. N.; Hosea, J. C. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1973. Contract AT(11-1)-3073. 15p. Dep. NTIS $3.00.

Experimental values of ac plasma impedance, measured over the frequency range of 50 Hz to 75 kHz, are compared with those predicted classically for the experimental electron temperature and density profiles. These comparisons suggest that the resistivity is anomalously high towards the boundary of the plasma and that in the dc limit the current density distribution is somewhat more peaked than that obtained assuming $j_\phi(r) \propto T_e^{\frac{3}{2}}(r)$. (auth)

17403 UNIVERSAL OHM'S LAW FOR TOKAMAK PLASMAS. Ware, A. A. (Univ. of Texas, Austin). Nucl. Fusion; 13: No. 6, 793-798(Dec 1973).

For a stable tokamak plasma and given Z-value, it is shown that there is a universal relationship for the toroidal current density which is satisfied in all collisional regimes to within an accuracy of 6%. With Z = 1, the relationship is $j_\phi = \sigma_{||}(E\phi + V_r B_\theta + [0.32\,\tilde{Q}_r B_\theta/nT_e])$. The only exception occurs for Pfirsch–Schuleter transport where the coefficient of the electron heat flux $\tilde{Q}_r$ changes from 0.32 to 0.28. This universal relationship is derived from published transport equations and also directly. It is an extra relationship between the fluxes which results because the first-order Larmor radius perturbation to the electron distribution function has approximately only two moments. (auth)

17404 THEORY OF GENERALIZED IMPACT INTEGRAL. II. Istomin, V. V.; Dovgopol, S. P. (Ural Polytechnical Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 119-122 (1973). (In Russian).

The method of nonstationary diagram summation was applied to the construction of impact integrals for classical plasmas in which circular diagrams with preliminary scale renormalization were considered which is equivalent to a consideration of the screening of long-range potential and final pulse transmission during binary impact. For three-dimensional homogeneous plasmas, it was shown that in the impact integral obtained, the impact cross section does not maintain the characteristic Coulomb divergence. (tr-auth)

17405 SIMILARITY THEORY AND INCREASED NEUTRON YIELD IN A PLASMA FOCUS. Imshennik, V. S. (Inst. of Applied Mathematics, Moscow); Filippov, N. V.; Filippova, T. I. Nucl. Fusion; 13: No. 6, 929-934(Dec 1973).

Satisfactory agreement was obtained between the MHD model and the experimental behavior of a plasma focus. On the basis of this agreement and similarity theory, the authors formulate various sets of predictions relating to a device with a high energy content. The authors discuss the different sets of predictions and estimate the associated degree of uncertainty. The relationship, derived from extrapolation of the theoretical results, between neutron yield and capacitor bank energy is confirmed experimentally by increasing the latter several times. (auth)

Production

17406 (UCID-16425) INVERSE BREMSSTRAHLUNG ABSORPTION COEFFICIENT AND INITIATION OF LASER-SUPPORTED DETONATION WAVES IN AIR. Winslow, A. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Dec 1973. Contract W-7405-eng-48. 18p. Dep. NTIS $3.00.

The inverse bremsstrahlung absorption coefficient in LASNEX was modified for application to laser effects calculations at temperatures below 10 eV. These modifications are described and the initiation condition for a laser-supported detonation (LSD) wave is crudely estimated for air in the vicinity of a solid target. (auth)

17407 (UCRL-75167) THEORETICAL DESCRIPTION OF PULSED LASER-TARGET INTERACTION IN AN AIR ENVIRONMENT. Edwards, A.; Ferriter, N. M.; Fleck, J. A. Jr.; Winslow, A. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Oct 1973. 37p. (CONF-731049-1). Dep. NTIS $4.00.

From 1973 DoD laser effects/hardening conference; Monterey, California, USA (22 Oct 1973).

A comprehensive treatment of pulsed laser-target interaction in an air environment is described. Included in the treatment is target heating and vaporization, nonequilibrium effects and two-dimensional hydrodynamics, radiative transfer, and thermal conduction. A description of damage effects arising from LSD waves is also given. (auth)

17408 MECHANISMS OF NEUTRON GENERATION IN A LASER PLASMA. Basov, N. G.; Boiko, V. A.; Zakharov, S. M.; Krokhin, O. N.; Mikhailov, Yu. A.; Sklizkov, G. V.; Fedotov, S. I. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 5, 184-186(5 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 5, 314-317(5 Sep 1973).

The mechanisms whereby neutrons are generated in a plasma are discussed on the basis of the experimental data for different heating regimes. It is established that in the case of sharp focusing of the radiation (10 to 20 GW power and 2 nsec duration) the bulk of the neutron yield is due to gasdynamic acceleration of the expanding plasma, and is nonthermal in character. In the case of spherical irradiation (power 300 GW, duration 1.5 nsec), the neutrons produced in a dense CD_2 plasma (10^7/pulse) are thermal. (auth)

17409 SHORT-PULSE-LASER-HEATED PLASMA EXPERIMENTS. Soures, J.; Goldman, L. M.; Lubin, M. (Univ. of Rochester, NY). Nucl. Fusion; 13: No. 6, 829-838(Dec 1973).

The interaction between time-tailored, high-intensity laser radiation and spherical light-element targets is investigated. Simultaneous measurements of the laser plasma electron temperature, charged-particle distribution, absorbed energy, neutron yields, and backscattered light intensity and spectra were made. For 100 ps, wide laser pulses focused to intensities ranging between 3×10^{15} and 2×10^{16} W/cm^2 on 150 to 200-μm-diameter LiD and $C_{26}D_{74}$ targets, plasmas with electron temperatures up to 1.2 keV and target-generated yields of up to 4×10^4 neutrons are produced. The absorption can be accounted for by inverse bremsstrahlung and no significant contributions due to parametric instabilities are observed. No more than 10^{-1} of the incident laser energy is back-reflected into spectral components at ω_L, $(\frac{3}{2})\omega_L$, and $2\omega_L$. (auth)

Stability

17410 (CONF-720976-4) NONLINEAR EFFECTS IN THE INTERACTIONS OF ELECTROMAGNETIC FIELDS WITH A COLLISIONLESS PLASMA. Gekker, I. R. (AN SSSR, Moscow. Fizicheskij Inst.). 1973. 67p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.50.

From conference on interaction of electrons with strong electromagnetic field; Balatonfuered, Hungary (11 Sep 1972).

A review of experimental and theoretical papers is given. Data are presented on ionospheric, laser, and microwave interaction studies for collisionless plasmas. An attempt is made to explain the experimental nonlinear effects in terms of the development of the parametric instability of a plasma located in an electromagnetic field. The data obtained indicate the values of threshold plasma densities for its microwave containment and radiative acceleration. (auth)

17411 (NP-19929) THRESHOLD OF DECAY INSTABILITY IN INHOMOGENEOUS PLASMA. Pilya, A. D. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 7p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The decay instability arises when two parametrically coupled waves have their turning points inside the plasma layer. Since not only an amplification but also a nonlinear conversion occurs in the region of the resonant interaction, reflections give rise to feedback, therefore temporal growth of the wave amplitudes becomes possible. The condition for this instability is shown to be $e^{2\pi\alpha} > 2$, where $e^{2\pi\alpha}$ is the parametric amplification rate, instead of $e^{2\pi\alpha} > e^{1\delta}$ when there is no feedback. This reduces the threshold value of the driving field by a factor of 3. (auth)

17412 STABILITY OF PLASMAS PENETRATED BY NEUTRAL GAS. Lehnert, B. (Royal Inst. of Tech., Stockholm). Nucl. Fusion; 13: No. 6, 781-791(Dec 1973).

For a plasma body of density, n, and characteristic macroscopic dimension, L_c, there exists a critical ion density $n_c = 1/\sigma_{cm}L_c$ where $\sigma_{cm} \simeq 3 \times 10^{-19}$ m^2 for hydrogen. When $n \lesssim n_c$ the plasma is permeable to neutral gas, whereas it becomes impermeable to the same gas when $n \gg n_c$. Permeable and impermeable plasmas have different equilibrium and stability properties. So far, tokamak experiments have been performed in the range of permeable plasmas, whereas full-scale steady-state fusion reactors are likely to operate in the impermeable range. The effects of plasma-neutral-gas interaction, finite resistivity, and viscosity on the gravitational instability modes of a magnetized plasma were investigated. (1) There are both direct and indirect neutral-gas effects on the ballooning and flute modes. The direct effects are due to frictional forces from collisions, and the indirect ones to the influence of the plasma-neutral-gas balance on the unperturbed pressure and density distributions. (2) In an impermeable plasma, the driving mechanism of the ballooning and flute instabilities can be localized to a narrow, dense and cool, partially ionized boundary region, in which plasma-neutral-gas collisions and viscosity strongly reduce the instability growth rates. Further reductions of these rates are expected to arise in more advanced and nonlinear approaches. (3) In tokamaks, resistive ballooning modes should be practically unaffected by neutral-gas collisions. However, when n approaches n_c from below, a collisionless ballooning mode is expected to arise from an increase of the gradients in the boundary region. This behavior is consistent with observations, including adiabatic-compression experiments. (auth)

17413 SUFFICIENT STABILITY CRITERIA FOR GENERAL MHD-EQUILIBRIA. Lortz, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 13: No. 6, 817-819(Dec 1973).

It is shown that the energy variation can be estimated by an integral containing only quantities constant on a magnetic surface. This one-dimensional problem is treated like the cylindrically case. The result is a sufficient stability criterion that admits a decreasing pressure profile and a nonvanishing current density on the magnetic axis. Unlike the sufficient criteria known so far, the new criterion is applicable to axisymmetric configurations without interior conductors. (auth)

17414 COMPARISON BETWEEN NECESSARY AND SUFFICIENT STABILITY CRITERIA FOR AXIALLY SYMMETRIC

EQUILIBRIA. Lortz, D.; Nuehrenberg, J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 13: No. 6, 821-827(Dec 1973).

A new sufficient criterion for the stability of magnetohydrostatic equilibria and Mercier's criterion are compared for axially symmetric equilibria. For simplicity, the analysis is restricted to the neighborhood of the magnetic axis. The stability conditions lead to the existence of critical values of the rotational transform in the neighborhood of the magnetic axis which depend on three parameters: the ellipticity and triangularity of the plasma cross section and the poloidal current. The dependences are qualitatively similar for both criteria. In particular, the case of stationary resistive equilibria without material sources is investigated. Also, rough estimates for the critical values of the plasma β are given. D-shaped plasma cross sections with a diamagnetic poloidal current appear to be favorable. (auth)

17415 PARAMETRIC EXCITATION AND SUPPRESSION OF DRIFT WAVES BY LOWER HYBRID FIELDS. Sundaram, A. K.; Kaw, P. K. (Physical Research Lab., Ahmedabad, India). Nucl. Fusion; 13: No. 6, 901-912(Dec 1973).

The effect of a large-amplitude, spatially uniform electric field at lower hybrid frequency, applied across the static magnetic field, on the dispersion relations for low-frequency drift waves ($\omega << \omega_{ci}$) and drift cyclotron waves ($\omega \simeq \omega_{ci}$) in a collisionless plasma is investigated. It is found that the lower hybrid field can parametrically excite or suppress the drift waves. Expressions are derived for the threshold electric field required for such effects. A particularly interesting result is the possibility of exciting some new macroscopic instabilities when wave–particle resonances are ignored. The results of this investigation are likely to be relevant to some of the recently proposed schemes using lower hybrid waves for heating plasma ions up to fusion temperatures. (auth)

17416 EFFECT OF ELLIPTICITY ON THE COLLISIONAL TRAPPED-PARTICLE INSTABILITY. Tang, W. M. (Princeton Univ., NJ). Nucl. Fusion; 13: No. 6, 883-899(Dec 1973).

Stability criteria for the collisional trapped-particle instability in an axisymmetric, large-aspect-ratio tokamak with an elliptic cross section are derived. Comparison with the circular configuration indicates that an increase in the vertical ellipticity can lead to a factor-of-two reduction in the critical density below which the mode is unstable. The improvement is a result of an enhancement of both ion Landau damping and ion collisional damping in the boundary layer of the trapped ions. Collisions are treated via the Fokker–Planck operator and the resulting problem is solved, as in earlier work, by a variational method. Unlike previous treatments of resonant effects, Landau damping by trapped rather than untrapped ions is considered, and the damping rate is found to be approximately the same in magnitude as the untrapped rate derived in earlier work. Results are applied to design parameters for Princeton's PLT (Princeton Large Torus) device and for a reactor, and stability conditions for several tokamaks presently in operation are also determined. (auth)

17417 SHEAR STABILIZATION OF DRIFT-DISSIPATIVE INSTABILITIES. Gregoire, M.; Rolland, P. (CEN, Grenoble, France). Nucl. Fusion; 13: No. 6, 867-873(Dec 1973).

A linear hard-core configuration is used in a study of shear stabilization of drift-dissipative instabilities. A neutral-collision-dominated hydrogen plasma with $n_e = 10^{11}$ cm^{-3}, $T_e = 10$ eV and $T_i \simeq 1$ eV with a neutral gas pressure between 10^{-3} and 3×10^{-3} torr is produced. The spatial mode structure and dependence of the stabilization upon axial magnetic field, pressure, and shear are investigated by using correlation techniques. It is found that, in the presence of shear, the waves retain a drift wave structure ($k_{||} \simeq 0$), while the radial mode is essentially the lowest-order normal mode. A theory is developed that takes into account the collisional mechanism as well as axial ion motion. The stabilizing effect of the magnetic field is in quantitative agreement with the theory. A derived stabilization law, which depends upon neutral pressure, explains the experimental observation of either a normal-mode structure or a convective-noise-like pattern. (auth)

17418 LOW-FREQUENCY PARAMETRIC INSTABILITIES OF PLASMA IN VARIABLE ELECTRIC FIELD. Kitsenko, A. B.; Panchenko, V. I.; Stepanov, K. N. (Physical–Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 10, 1591-1598(Oct 1973). (In Russian).

Nonresonant parametric instabilities of plasma in the presence of the variable electric field with a frequency of the order of the lower hybrid frequency ω_{LH} or somewhat higher are considered. The growth rates for hydrodynamic oscillations of a cold plasma and for ion-sound and electron-sound oscillations are obtained in the case when the drift velocity of electrons with respect to ions is less than the thermal velocity of electrons and more than that of ions. The maximum value of the growth rate is comparable with that of the lower hybrid frequency. (auth)

17419 OBSERVATIONS ON THE DISTRIBUTION FUNCTION FOR A PLASMA WHICH IS FOUND IN AN ELECTRIC MODULATED FIELD. Baleanu, C. An. Univ. Timisoara, Ser. Stiinte Fiz.-Chim.; 9: No. 2, 89-95(1972).

The effect of an fm electric field on an inhomogeneous plasma is studied. The parametric excitation process is described. (Rom. Sci. Abstr.)

17420 SUYDAM INSTABILITY OF THE BELT PINCH. Ignat, D. W.; Hofmann, F. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Nucl. Fusion; 13: No. 6, 955-958(Dec 1973).

MHD simulations were performed of some belt-pinch experiments using a one-dimensional, three-fluid computer code. The present computations include self-consistently the interaction between the plasma and the external circuit. The results of a typical calculation are presented. (MOW)

17421 INSTABILITY-GENERATED LASER REFLECTION IN PLASMAS. Kruer, W. L.; Estabrook, K. G.; Sinz, K. H. (Univ. of California, Livermore). Nucl. Fusion; 13: No. 6, 952-955(Dec 1973).

The decay of laser radiation into another electromagnetic wave plus either an ion acoustic wave (Brillouin) or an electron plasma wave (Raman) is studied. The nonlinear evolution of these instabilities was studied in electromagnetic, relativistic-particle simulations. Particular attention is focused on relativistic-particle production by the Raman instability and laser light reflection by the Brillouin instability. Several techniques to reduce these instability effects are also presented. (MOW)

17422 ELECTROMAGNETIC AND ∇B-EFFECTS ON THE MODIFIED TWO-STREAM INSTABILITY. Lakhina, G. S.; Sen, A. (Physical Research Lab., Ahmedabad, India). Nucl. Fusion; 13: No. 6, 913-917(Dec 1973).

The electrostatic modified two-stream instability excited by transverse currents in an inhomogeneous magnetized plasma is studied in the domain where electromagnetic corrections become important ($\omega_{pe}^2/c^2k^2 \gtrsim 1$). The effects due to ∇B, the distortion in the magnetic field caused by transverse currents, are also included. They are found to affect growth rates and instability conditions for both flute ($k_{||} = 0$) and nonflute type modes significantly. (auth)

17423 FLUTE INSTABILITY IN A TOKAMAK OF ARBITRARY CROSS SECTION. Yavlinskii, Yu. N. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 13: No. 6, 951-952(Dec 1973).

Earlier Shafranov and Yurchenko (Nucl. Fusion 8(1968)329) obtained the necessary stability criterion of a plasma in an axisymmetric Tokamak of elliptical cross section, one of the axes of which is parallel to the axis of symmetry. This stability criterion is generalized for the case of an elliptical cross section of the magnetic surface near the magnetic axis. (MOW)

Thermonuclear Engineering and Equipment

17424 (BNWL-SA-4777) PRELIMINARY ASSESSMENT OF CORROSION PRODUCT TRANSPORT IN FUSION REACTORS. Johnson, A. B. Jr.; Vogelsang, W. F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 5 Nov 1973. 11p. (CONF-731101-48). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California USA (11 Nov 1973).

Corrosion which is tolerable from the standpoint of system mechanical integrity may cause substantial problems if the corrosion product is released and deposited at locations where it interferes with heat transfer or coolant flow. Furthermore, neutrons from the fusion reaction activate the corrosion product, causing radiation fields in maintenance areas near piping and components where the activated material deposits. Preliminary estimates suggest that formidable problems may occur in a lithium-cooled stainless steel primary circuit due to corrosion product deposition. If the estimated order of magnitude is confirmed in future studies, new concepts in corrosion control or corrosion product removal would need to be developed for lithium-cooled stainless steel CTR systems. Other fusion reactor system concepts and materials appear to offer alternatives which tend to minimize corrosion product transport. (auth)

17425 (BNWL-SA-4792) PROJECTION OF GRAPHITE BEHAVIOR: COMPARISON OF RESULTS ON FOUR CONCEPTUAL FUSION REACTOR DESIGNS. Gray, W. J.; Morgan, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1973. Contract AT(45-1)-1830. 20p. (CONF-731114-46). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A very brief review of radiation effects in graphite is given followed by projections of graphite behavior in four fusion reactor design concepts: the ORNL Conceptual Fusion Reactor (Version III), the University of Wisconsin Tokamak (Austin Design), the LASL Reference Theta Pinch Reactor, and the PNL Fusion–Fission Hybrid Reactor. These projections are based on property changes observed for graphite samples irradiated in fission reactors and the calculated numbers of atomic displacements. Correlations between the relative atomic displacements in the fusion and fission reactor spectra were made using the Lindhard theoretical treatment of atomic stopping cross sections and neutron scattering cross section data from ENDF/B-III. The results predict graphite lifetimes of roughly 2500, 7500, 200, and 10000 full power days for the above four reactor concepts, respectively, using the typical nuclear-grade graphites. Discussions of areas that require additional work to improve these and future projections are presented. (auth)

17426 (CONF-731114-45) ASPECTS OF THETA-PINCH POWER PLANT DEVELOPMENT. Coultas, T. A.; Krakowski, R. A. (Argonne National Lab., Ill. (USA)). 1973. 13p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

An engineering conceptual design study of a fusion power plant based on the theta-pinch concept has recently been completed. This study presented a compatible design for ten major systems. Although the design appears viable, some systems need considerable development to show that they are completely feasible and credible. Interactions between systems prevent implementation of some obvious solutions to the individual problems. Design alternatives, development, and demonstrations, as well as fundamental research required on these systems to make a feasible theta-pinch power plant are discussed. (auth)

17427 (IAE-2253) METHODS OF OBTAINING LIMITING ELECTRICAL OUTPUTS IN SHORT PULSES. Babykin, M. V.; Bartov, A. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The factors determining the limiting output and the rate of output build-up in different systems are examined. The conditions under which parameters necessary for initiation of thermonuclear reactions are produced are determined. (JSR)

17428 (LA-5474-P) PROPOSAL FOR THE CONSTRUCTION OF A SCYLLA IV-P CONFINEMENT STUDIES THETA PINCH. Ellis, W. R. Jr.; Riesenfeld, W. B.; Sawyer, G. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec. 1973. Contract W-7405-eng-36. 22p. Dep. NTIS $4.00.

An experimental linear theta-pinch device, called Scylla IV-P, is proposed to obtain important physical and technological data in support of the LASL high-beta confinement program. The major objective of this experiment will be to perform precise studies of the scaling laws for the growth rates of the most important magnetohydrodynamic modes acting in the Scyllac configuration. These experimental checks of theoretical predictions are expected to play a major role in defining the technological parameters of a Physics Test Reactor based upon the toroidal theta-pinch concept. Auxiliary and secondary goals for the Scylla IV-P device will be finite-ion-gyro-radius effects studies, high-field coil development, wall-stabilization experiments, high-density linear theta-pinch studies, and diagnostic development. (auth)

17429 (MATT-1008) SWAN: A CODE FOR THE ANALYSIS AND OPTIMIZATION OF FUSION REACTOR NUCLEONIC CHARACTERISTICS. Greenspan, E.; Price, W. G. Jr.; Fishman, H. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1973. Contract AT(11-1)-3073. 87p. Dep. NTIS $6.50.

This report is intended as a User's Manual for "SWAN"—a code written for perturbation theory analysis and optimization of the nucleonic characteristics of fusion reactor blankets. SWAN is also applicable to any problem described by the inhomogeneous linear transport equation, e.g., radiation shield problems. The optimization method is based on variational techniques. The variables of the optimization are material densities, with no restriction on their number. One joint restraint may be imposed in addition to upper and lower limits on each density. The parameter to be extremized and the restraint may be either a weight-type (linear) or nucleonic (bilinear) functional. The transport calculations for SWAN are performed with the one-dimensional discrete-ordinate code ANISN. (auth)

17430 (MATT-1010) THERMAL STRESS UNDER HIGH-POWER SURFACE HEATING. Schivell, J. F.; Grove, D. J. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1973. Contract AT(11-1)-3073. 13p. Dep. NTIS $3.00.

Estimates are made of thermal stress in a wall subjected to transient heating on one side. A detailed calculation is carried out for a flat plate heated on one face and cooled on the other. These examples furnish a guide to power absorption limits for surfaces in high-power plasma devices. Figures of merit are tabulated for various possible materials. (auth)

17431 (MATT-1012) IMPURITY CONCENTRATION IN THE ATC. De Marco, F. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1973. Contract AT(11-1)-3073. 10p. Dep. NTIS $3.00.

The impurity level in the ATC before compression was investigated by spectroscopic measurements. The first experimental results concerning the concentrations and the influence of impurities on some discharge characteristics are given. (auth)

17432 ATTAINMENT OF GIGAVOLT POTENTIALS BY MAGNETIC INSULATION. Winterberg, F. (Univ. of Nevada, Reno). Nature (London); 246: No. 5430, 299-300(30 Nov 1973).

A toroidal machine is described that has two concentric conductors of toroidal symmetry placed within a toroidal magnetic field coil producing a magnetic field directed along the circular toroidal ring axis and varying in time. The space inside the inner conductor and in between the inner and outer conductors is a hard vacuum. The inner conductor has no physical support in relation to the outside structure and is levitated. This can be effected by making the inner conductor, or certain parts of it, from a ferromagnetic substance, the use of an auxiliary external feedback-controlled magnetic field coil then keeping the inner conductor stable in its position. The external conductor is surrounded by a toroidal magnetic field coil fed by a high current generator. Both the inner and outer conductors have a nonconducting gap. If the external coil is magnetized by the generator the magnetic field created can flow freely through the gaps first into the space between the outer and inner conductors and then into the space within the inner conductor. As a result the whole of the space inside the toroidal magnetic field coil will be filled with magnetic field. If a cathode is placed within the gap of the outer conductor, emitting thermionic electrons, and if the externally applied magnetic field rises in time, then these electrons will be attached to and carried by the magnetic field lines moving toward the inner conductor. After reaching the inner conductor the electrons will detach themselves from the magnetic field lines and will form a surface charge on the inner conductor. The outer conductor, on the other hand, will be charged positively. The inner and outer conductors thus form a coaxial capacitor charged to some electrostatic potential. As long as the axial magnetic field strength is greater than the radial electric field strength the magnetic field acts as an insulator, with no dielectric breakdown limitations. Because of the large magnetic fields attainable it is expected that this type of magnetically insulated capacitor can be charged up to very high potentials, and energy storage would be considerable. After the voltage has reached its peak value controlled breakdown will occur at a properly placed gap between a protrusion of the inner conductor and an auxiliary guide electrode in the form of a rod. The machine can work in a rapid sequence at very high average power levels that are unattainable in conventional particle accelerators. The two most important applications of the machine are stated to be for controlled thermonuclear fusion work and for the collective acceleration of ions to ultrahigh energies. (UK)

17433 OPERATING REGIMES OF CONTROLLED THERMONUCLEAR REACTORS AND STABILITY AGAINST FUNDAMENTAL-MODE EXCURSIONS IN PARTICLE DENSITIES AND TEMPERATURES. Stacey, W. M. Jr. (Argonne National Lab., IL). Nucl. Fusion; 13: No. 6, 843-861(Dec 1973).

A point model of particle densities and temperatures within a CTR is formulated, and equilibrium solutions are obtained for different plausible operating regimes of a D–T reactor of commercial interest. The stability of these equilibrium points against excursions in the overall particle densities and temperatures is determined by linear analysis and confirmed by dynamic simulation—certain regimes are found to be unstable. Control of a CTR about an unstable equilibrium point by varying the injected ion intensity and D–T mixture is investigated and found to be difficult when the ion containment time is not large with respect to the delay time between consecutive changes in the injected ion beam. (auth)

17434 STUDY OF THE MAGNETIC WELL CREATED BY A YIN–YANG CONFIGURATION. Leloup, C.; Waldes, J. (CEN, Fontenay-aux-Roses, France). Nucl. Fusion; 13: No. 6, 863-866(Dec 1973).

A systematic study was carried out when the parameters of the Yin–Yang configuration were varied in order to obtain the maximum mirror ratio, $\mathcal{R}$, for the last closed nested isobar of the magnetic well. It was found that the maximum values of $\mathcal{R}$ obtained are about 2.5, even when the mirror ratio along a line of force attains a large value ($\simeq 5$). Optimization of the access for fast neutral injection is included. (auth)

17435 TECHNOLOGICAL PROBLEMS OF THE FUSION REACTOR. Discussion of the Memorandum on the Fusion Reactor in Berlin. Andresen, H. (Hahn–Meitner-Institut fuer Kernforschung, Berlin). Atomwirt., Atomtech.; 18: No. 11, 546-547(Nov 1973). (In German).

A brief report is given of the various topics dealt with during the discussion of the memorandum on technological problems of the fusion reactor. The main topics discussed are: plasma experiments (tokamaks, stellarators, mirror devices, inertial confinement); plasma–wall interactions, plasma heating, materials problems, electrotechnical problems, and system analyses. (GE)

17436 PROBLEMS OF MEASURING NUCLEAR CONSTANTS FOR THERMONUCLEAR REACTORS. Kuz'min, E. A.; Ogloblin, A. A.; Sidorov, N. I.; Faiziev, A. R.; Chulkov, L. V.; Yan'kov, G. B. (Inst. of Atomic Energy, Moscow). pp 3-19 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In Russian)

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 2); CONF-730302-(Vol. 2).

From the available nuclear data it appears that a tritium breeding coefficient greater than unity can be obtained in a thermonuclear reactor using the D–T cycle and with a breeding zone consisting of a mixture of lithium isotopes. However, the present inaccuracies in the nuclear data may considerably influence tritium breeding and the optimum relationship between breeder and construction materials. A fairly extensive program of neutron research in the neutron energy range 7 to 14 MeV is therefore necessary. The main feature of neutron measurements within this range is that there are no monoenergetic neutron sources available. The possibilities are considered for using normal sources—the reactions D + D, D + T, T + p. Measurement data are presented on the continuous neutron spectrum in the reaction T + p, which limits the use of this reaction as a source of monoenergetic neutrons. Neutron sources based on the use of alpha particles and ^{3}He ions are considered and currently available sources of continuous-spectrum neutrons are discussed. It is shown that the optimum source of a continuous spectrum of neutrons in the required energy range is deuteron disintegration at $E_d \simeq 25$ to 40 MeV. (auth)

17437 INFLUENCE OF NUCLEAR DATA ON TRITIUM BREEDING IN A THERMONUCLEAR REACTOR. Ogloblin, A. A.; Chulkov, L. V.; Yan'kov, G. B. (Inst. of Atomic Energy, Moscow). pp 21-40 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973). (In Russian)

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 2); CONF-730302-(Vol. 2).

The influence of nuclear data on the tritium breeding coefficient in a thermonuclear reactor using the D–T cycle is discussed. A spherical isotopic source of 14-MeV neutrons surrounded by a monoisotropic wall and a tritium breeding zone is taken as a model. A homogeneous mixture of ^{6}Li, ^{7}Li, and some isotope which simulates the construction materials within the breeding zone without forming tritium under the action of neutrons is chosen as the tritium breeding zone. The tritium breeding coefficient is calculated by the Monte Carlo method for various wall and zone thicknesses and various isotopic compositions within the zone. Total and differential cross sections characterizing the main processes of interaction between neutrons and lithium isotopes, the shape of the energy spectrum of the secondary neutrons for lithium, and cross sections characterizing the wall material and the impurities are used as input data. The interaction of secondary charged particles with the blanket substance is ignored. Within the limits of the experimental errors, some of the input data is varied and the sensitivity of the tritium breeding coefficient to such variations is studied. The influence of such variations on the relationship between breeder and construction materials is also studied. On the basis of the calculations, recommendations are made regarding the priority and required accuracy of neutron constant measurements for a thermonuclear reactor. (auth)

17438 FUSION REACTION RATE FROM TRUNCATED MAXWELLIAN DISTRIBUTIONS. Dolan, T. J.; Stansfield, B. L. (Univ. of Quebec, Varennes). Nucl. Fusion; 13: No. 6, 960-962(Dec 1973).

The use of electrostatic fields in cusp confinement systems is discussed. Ions are lost mainly by maxwellization, with the high-energy tail removed as these ions have sufficient energy to surmount the potential barrier. Thus, the maxwellian is truncated, with the cutoff energy equal to the potential-well depth. Reaction-rate calculations are given for various fusion reactions from 1 to 100 keV. It is concluded that satisfactory fusion reaction rates can be obtained with the D–T reaction if potential well depths of approximately 100 keV can be produced. (MOW)

17439 ENERGY BALANCE IN FUSION ROCKETS. Powell, C.; Hahn, O. J.; McNally, J. R. Jr. Astronaut. Acta; 18: No. 1, 59-69(Feb 1973).

A theoretical study on application of fusion reaction propulsion for interstellar space missions shows that lower-than-optimum exhaust velocities of such thrusters are adequate. Convincing derivation of equilibrium optimization parameters and some comparison with gaseous-core fission propulsion system are offered. Use of deuterium (D–D), equimolar mixtures of deuterium with tritium (D–T) and of deuterium with helium-3 (D–^{3}He), are used as fuel examples. Departure from the previously chosen pulsed system permits lower mass-to-exhaust power ratio. Toroidal reactor with shielded superconducting coils outside the plasma represent potential advancement in the state of art for such propulsion systems. The unknown factors in this concept, such as the diffusion coefficients, limit quantification of some operating criteria for the derived system performance. Mathematical treatment and 11 graphical illustrations of the principal parameters are well conceived. Calculated effective exhaust velocities for the D–D system are in the range from 4000 to nearly 8000 km/sec; for the D–T system, from about 2500 to 5500 km/sec; and for the D–^{3}He system, from 3200 to 9000 km/sec. The gradual evolution of space programs will benefit from these analytical efforts. More studies are, however, needed to develop confidence in such a concept. Key parts of the conceptual analysis are correlated with 20 references, giving excellent insight into other related and peripheral treatments of interstellar propulsion. (Appl. Mech. Rev.)

Wave Phenomena

17440 (NP-19919) PARAMETRIC EXCITATION OF WAVES IN MAGNETIZED PLASMA. Andreev, N. E.; Batanov, G. M.; Sarksyan, K. A. (AN SSSR, Moscow. Fizicheskij Inst.). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The variations of wave intensity that are parametrically driven by uhf pumping in the magnetized collisionless plasma are investigated. Experiment results are also presented on the nonlinear saturation of plasma wave amplitudes. (tr-auth)

17441 (NP-19920) ANOMALOUS ABSORPTION OF MICROWAVES BY PLASMA NEAR THE UPPER HYBRID FREQUENCY. Anisimov, A. I.; Vinogradov, N. I.; Poloskin, B. P. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The interaction of microwaves with a plasma obtained in a toroidal chamber was investigated. It was found that wave absorption was localized in the regions where plasma density and magnetic field met the upper hybrid resonance condition. The dimension of the absorption region was independent of neutral gas pressure. In the absorption region the low-frequency oscillations were observed which seemed to be ion-acoustic. The conclusion is made that the absorption is due to parametric instability. (auth)

17442 (NP-19921) EXPERIMENTAL OBSERVATION OF A DECAY OF HIGH-FREQUENCY WAVES IN PLASMA. Anisimov, A. I.; Vinogradov, N. I.; D'yachenko, V. V.; Shcherbinin, O. N. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The interaction of electromagnetic waves with a plasma of a toroidal discharge was investigated. The wave was near the plasma frequency and lay between the ion and electron cyclotron frequencies. The oscillations with frequencies somewhat different from the pumping wave were found when the power exceeded the threshold of 10^{-3} to 10^{-2} W. At the same time the low-frequency oscillations were registered which seemed to be ion-acoustic. (auth)

17443 (NP-19923) WAVE ABSORPTION BY TWO-DIMENSIONAL HETEROGENEOUS PLASMA NEAR SPECIAL POINTS. Arkhipenko, V. I.; Budnikov, V. N.; Obukhov, A. A. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The connection between the wave absorption by two-dimensional

heterogeneous plasma in a magnetic field and special point existence was experimentally demonstrated. During the experiment, for $\omega < \omega_p$, $\omega_{he} > \omega > \sqrt{\omega_{he}\omega_{hi}}$, a singularity originates on the line of the constant concentration for $n = n_c$. This phenomenon is observed at the point where the line of the constant concentration is perpendicular to the magnetic field. The absorption efficiency was shown to decrease sharply with the special point liquidation. (auth)

17444 (NP-19924) WAVE ABSORPTION BY PLASMA WITH NONMONOTONIC LONGITUDINAL CONCENTRATION DISTRIBUTION. Arkhipenko, V. I.; Budnikov, V. N.; Obukhov, A. A. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

An experiment is described concerning wave absorption (for $\omega_{he} > \omega > \omega_{he}\omega_{hi}$ frequencies) by specially formed plasma with a minimum of a longitudinal distribution. The experiment was carried out using argon plasma for 10^{-3} mm Hg pressure, ω = 975 Mhz operating frequency, and $\omega_{he}/\omega = 9.4$. The absorption existence for $n \gg n_c$ concentrations was found. Boundary concentration value satisfactorily corresponds to the theoretical one of the transformation region calculated for plasma experimental parameters. (auth)

17445 (NP-19925) SUPER-HIGH-FREQUENCY WAVE ABSORPTION BY PLASMA IN MAGNETIC FIELD FOR A SIGNIFICANT INFLUENCE OF THE LONGITUDINAL INHOMOGENEITY. Arkhipenko, V. I.; Budnikov, V. N.; Obukhov, A. A. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

An investigation is presented of a superhigh-frequency wave absorption by plasma which is inhomogeneous over two directions, length and radius. The density drop in the longitudinal direction is twice that in the radial direction. Experimental conditions are: $\omega < \omega_p$, $\omega_{he} > \omega > \sqrt{\omega_{he}\omega_{hi}}$, where ω_{he}, ω_{hi} are the electron and ion cyclotron frequencies; ω_p is the plasma frequency. The longitudinal plasma inhomogeneity has to influence significantly the absorption process under those conditions. The shf absorption excited in this inhomogeneous plasma was shown to result locally near the point on the axis where the density is equal to the critical one. The wave deceleration and local electron heating take place near this point. The absorption is connected with a special point on the critical density line. This point is at the place where the line is perpendicular to the magnetic field lines of force. (auth)

17446 (NP-19926) INTERACTION OF MICROWAVE RADIATION WITH A STREAM OF COLLISIONLESS PLASMA INSULATED FROM WAVEGUIDE WALLS. Barinov, V. I.; Gekker, I. R.; Ivanov, V. A.; Karfidov, D. M. (AN SSSR, Moscow. Fizicheskij Inst.). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A hydrogen–carbon plasma was injected into a metal waveguide through a diaphragm which restricted the transverse dimension of the plasma stream. The diaphragm had a metal grid and was placed at a distance of 60 cm from the source. A pulsed microwave generator was switched on when the plasma front was 6 to 7 cm from the diphragm. Microwave absorption and reflection measurements are described. It is shown that wall effects do not play a dominant role in anomalous dissipation of microwaves in plasma. (tr-auth)

17447 (NP-19930) ELECTROMAGNETIC WAVE INTERACTION WITH PLASMA OF A TOROIDAL DISCHARGE. Gladkovskii, I. P.; Golant, V. E.; D'yachenko, V. V.; Larionov, M. M.; Levin, L. S.; Rozhdestvenskii, V. V.; Sadovnikov, V. A.; Shcherbinin, O. N. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Tokamak FT-I device at the A. F. Ioffe Physico-Technical Institute is described. Ohmic heating and electromagnetic wave interaction with plasma in the lower hybrid frequency range are studied. It is found that energetic ions are generated by high-frequency power in the plasma. (auth)

17448 WEAK-TURBULENCE KINETIC THEORY OF WAVE–WAVE INTERACTION. Casati, G.; Maroli, C.; Uttica, G. (CNR, Milan). Physica; 68: No. 3, 624-628(15 Sep 1973).

The derivation of the kinetic equation for wave–wave interaction in a spatially homogeneous, dispersive system is critically examined. The integro-differential equation for the energy-spectrum function which is obtained seems to be more general, retaining in particular its validity also in the presence of the so-called "double resonances". (auth)

17449 STABILITY OF LARGE-AMPLITUDE RELATIVISTIC NONLINEAR PLASMA WAVES. Jancarik, J. (Culham Lab., Abingdon, Eng.); Tsytovich, V. N. Nucl. Fusion; 13: No. 6, 807-816(Dec 1973).

Stability properties of large-amplitude, relativistic nonlinear plasma waves are investigated by solving the Cauchy problem for the motion of a relativistic electron fluid with uniform stationary ion background. The development of a stationary large-amplitude relativistic wave is studied under the influence of initial perturbations of electric field and particle velocities. Stochastic initial perturbations are slightly damped with time; in the case of parametric initial perturbations, a perturbation growth is followed by nonlinear saturation and decay. Under some conditions, particle interstreaming can develop but it does not significantly influence the large potential wells in the wave. (auth)

17450 THEORY OF ELECTROMAGNETIC-WAVE SCATTERING IN A STRONGLY TURBULENT PLASMA. Sakhokiya, D. M. (Tbilisi State Univ., USSR); Tsytovich, V. N. Nucl. Fusion; 13: No. 6, 799-806(Dec 1973).

A theory for the scattering of high-frequency electromagnetic waves in a strongly turbulent plasma in an external magnetic field is considered. In constructing the theory, no definite connection between the frequency ω_l and the wave vectors k_l of the turbulent plasma oscillations is assumed, which is in keeping with strong turbulence. High-frequency electromagnetic waves interacting with uncorrelated turbulent oscillations change their correlation functions. There arises a certain indeterminacy in the relationship between the frequencies and wave numbers of the high-frequency electromagnetic waves. The theory makes it possible to consider the correlations of high-frequency waves in a turbulent plasma. The results can be used in the diagnosis of strong turbulence. Examples of strong drift instability and Buneman instability are considered. (auth)

17451 ROLE OF TURBULENCE ON RADIATION FROM RADIATING SOURCES IN PLASMAS. Sharma, S. C. (Princeton Univ., NJ). J. Phys., A (London); 6: No. 12, 1954-1959 (Dec 1973).

The role of turbulence on the radiation pattern of a radiating source (antenna) is discussed. A partial analysis of the radiation from an electric dipole in a turbulent plasma medium is made and an expression for the total energy flux of the dispersed field is obtained. The energy flux of the dispersed field is calculated for the plasma parameters in different situations. (auth)

17452 INTERACTION OF A MODULATED ELECTRON BEAM WITH AN INHOMOGENEOUS PLASMA. Berezin, A. K.; Berezina, G. P.; Matsiborko, N. G.; Fainberg, Ya. B.; Shapiro, V. D.; Shevchenko, V. I. (Physico-Technical Inst., Kiev). Nucl. Fusion; 13: No. 6, 925-927(Dec 1973).

A theoretical study is presented of the excitation of a monochromatic plasma wave by a modulated electron beam in an inhomogeneous plasma when synchronism is maintained between the beam and the excited wave. Results are also given of experimental studies on the interaction of a modulated beam with a homogeneous and an inhomogeneous plasma. (auth)

17453 NONSTATIONARY SHOCK WAVES IN RAREFIED PLASMA. Dudnikova, G. I. Zh. Prikl. Mekh. Tekh. Fiz.; No. 3, 10-15(1973). (In Russian).

Nonstationary collisionless shock waves in plasma propagated under arbitrary angles to the undisturbed magnetic field in the presence of conduction and electron thermal conductivity was investigated with numerical methods. (tr-auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 15965, 15970, 16419, 16454, 16786, 16845, and 17703.

17454 (ORNL-4933) ENERGY DEPOSITION BY 45-GeV PHOTONS IN H, Be, Al, Cu, AND Ta. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 12p. Dep. NTIS $4.00.

Electron–photon cascade calculations have been carried out for zero-width beams of 45-GeV photons normally incident on semi-infinite slabs of hydrogen, beryllium, aluminum, copper, and tantalum. The energy deposition is given as a function of both depth and radius in the slabs. (auth)

17455 (ORNL-TM-4369) CALCULATIONS RELATED TO THE USE OF PHOTONS, NEUTRONS, NEGATIVELY CHARGED PIONS, PROTONS, AND ALPHA PARTICLES IN CANCER RADIOTHERAPY. Alsmiller, R. G. Jr.; Santoro, R. T.; Armstrong, T. W.; Barish, J.; Chandler, K. C.; Chapman, G. R. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 69p. Dep. NTIS $5.50.

Calculated results are presented for absorbed dose, LET spectrum, and cell-survival probability as a function of position when photons, neutrons, negatively charged pions, protons, and alpha particles are incident on a tissue phantom. The beam parameters for each type of incident particle were chosen to be approximately those appropriate to the single-port irradiation of a small cylindrical volume (1 cm in radius and 2 cm in height) centered about a depth of 15 cm in the 30-cm-thick tissue slab. Both monoenergetic (15 MeV) neutrons and neutrons produced by 35-MeV ^{2}H on Be are considered. The cell-survival-probability calculations are carried out using the model developed by R. Katz et al., and results are presented for both aerobic and anoxic T-1 kidney cells. Spatially dependent OER's and RBE's for each type of particle considered are also given. (auth)

17456 (ORNL-TM-4411) MEASUREMENT OF ABSORBED FRACTIONS FOR PHOTON SOURCES DISTRIBUTED UNIFORMLY IN VARIOUS ORGANS OF A HETEROGENEOUS PHANTOM. Garry, S. M.; Stansbury, P. S.; Poston, J. W. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 76p. Dep. NTIS $6.00.

Thesis. Submitted by S. M. Garry to Univ. of Tennessee, Knoxville.

A physical representation of the Snyder–Fisher heterogeneous mathematical phantom has been designed and constructed. The phantom is suitable for studies involving radiation dose distributions in Reference Man from both internally and externally applied radiation fields. The physical phantom contains skeletal components, lungs, and soft-tissue regions similar to the mathematical Snyder–Fisher phantom. A complete description of the phantom and its composition is given. The phantom was used to determine dose distributions within the phantom resulting from photon emitters distributed uniformly in selected organs. These dose distributions were used to determine absorbed fractions for the mathematically defined phantom organs. The absorbed fractions are given and are compared with the absorbed fraction estimates by Snyder, et al. In general, estimates of the absorbed fractions, obtained experimentally, fall within the range predicted by twice the coefficient of variation of the calculated value. (auth)

17457 (ORNL-TM-4451) TECALC: A PROGRAM TO CALCULATE COMPTON, COHERENT, AND PHOTOELECTRIC MASS ATTENUATION COEFFICIENTS FOR PHOTONS WITH ENERGIES LESS THAN 1 MeV AND TO ASSIST IN THE EVALUATION AND FORMULATION OF PHOTON-EQUIVALENT MATERIALS. Stansbury, P. S. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 36p. Dep. NTIS $4.00.

TECALC is a BASIC program, written for the PDP-10, which (1) can be used to calculate the Compton, coherent, and photoelectric partial mass attenuation coefficients, the total mass attenuation coefficient, and the mass absorption coefficient for known materials, and (2) can be used in an interactive, iterative mode to assist the user in formulating mixtures of materials which have partial mass attenuation coefficients similar to a given material of interest. The program is capable of handling complex mixtures or solutions of compounds in a manner which simplifies input. The program can be used to calculate coefficients for mixtures or solutions of compounds of 19 of the most common elements in biological or biological-equivalent materials. Coefficients are calculated at 17 logarithmically spaced intervals from 10 keV to 1 MeV. The program is designed to be used in the timesharing mode and can be run by a user who has only a rudimentary knowledge of BASIC programming. (auth)

17458 DETERMINING TOTAL CROSS-SECTIONS OF ELECTRON RADIATION LOSSES. Dmitrov, G. N. At. Energ. (USSR); 35: No. 1, 50(Jul 1973). (In Russian).

An empirical formula for the total cross-section of electron radiation losses is given as a function of the energy of the bombarding electrons and the charge of the medium in which slowing occurs: $\sigma = 5.373 \times 10^{-3}\ Z \exp(1.901)\ E \exp(0.292\ Z^{-0.547})$. Z is the charge of the slowing medium. E is the kinetic energy of the electrons in MeV. For hydrogen $\sigma_H = 7.58 \times 10^{-3}\ E \exp(0.286)$. The values obtained from these equations do not differ by more than 7% from values obtained by more detailed calculations. The total electron energy losses from radiation are calculated as follows $-(dE/dx)_{rad} = (N/A)\ E\sigma$. Here N is Avogadro's number; A is the mass of the stopping medium, and E is the total electron energy in MeV. (SJR)

17459 BETA-RAY DOSE IN TISSUE-EQUIVALENT MATERIAL IMMERSED IN A RADIOACTIVE CLOUD. Berger, M. J. (National Bureau of Standards, Washington, DC). Health Phys.; 26: No. 1, 1-12(Jan 1974).

The radioactive-cloud immersion problem for beta-radiation has been treated schematically by assuming a semi-infinite air medium (source region) located adjacent to a semi-infinite water medium (tissue-equivalent target). The source region has been assumed to contain a uniform concentration of beta-emitting radionuclide, and calculations have been made of the absorbed-dose distribution (depth dose) in the water target. A leakage correction has also been made to estimate the reduction of absorbed dose that would occur if the target had lateral dimensions small compared to the beta-particle range in air. Depth-dose calculations have been carried out for various source spectra (including beta-ray as well as discrete electron spectra) for ^{83m}Kr, ^{85m}Kr, ^{85}Kr, ^{87}Kr, ^{88}Kr, ^{88}Rb, ^{131m}Xe, ^{133m}Xe, ^{133}Xe, ^{135}Xe, ^{137}Xe, ^{137}Cs, ^{138}Xe, and ^{138}Cs, being rare gases emitted by nuclear power plants into the atmosphere, and for ^{3}H, ^{14}C, ^{35}S, ^{125}I, ^{24}Na, ^{32}P, ^{42}K, ^{90}Y, ^{60}Co, ^{89}Sr, ^{90}Sr, ^{131}I, being commonly used radionuclides. (auth)

17460 ION CURRENT MEASUREMENTS IN GASEOUS MIXTURES CONTAINING AMMONIA. Green, P.; Hunter-Kranc, L. M.; Johnsen, R. H. (Florida State Univ., Tallahassee). Radiat. Res.; 56: No. 2, 222-231.

Measurements of ionization currents have been made in the following gases and their binary mixtures: NH_3, N_2, O_2, Air, Ar, CH_4. For the pure substances present results are in agreement with those previously obtained with the exception of NH_3 which was previously measured only at high pressures. The value obtained in this work is 28.59 eV/ion pair. In the case of the various mixtures with ammonia a number of deviations from ideality were noted. These can be reconciled with the Huber equation by the adoption of Klots' effective atomic numbers and the assignment of $Z' = 10.0$ to ammonia. (auth)

17461 ABSORBED DOSE DUE TO BETA-RAYS FROM RADIOACTIVE COLLOIDS IN RADIATION SYNOVECTOMY. Husak, V.; Wiedermann, M.; Kral, M. (Palackeho Univ., Olomouc, Czech.). Phys. Med. Biol.; 18: No. 6, 848-854(Nov 1973).

Assuming that colloidal particles of ^{198}Au or ^{90}Y are adsorbed by the synovial surface so that they form a very thin plane source of activity, the dependence of the absorbed dose on the distance from the source is calculated. Considering an infinitely thin plane source, a model often used in the literature, excellent agreement among the three methods is obtained at distances above 0.05 mm. A plane source having a thickness of 20 to 30 μm appears to be a more reasonable model, approximating more closely to the actual distribution of colloidal particles in the synovial membrane. These two approaches are compared and shown to give the same dose at distances greater than 0.1 mm. (auth)

17462 EXPERIMENTAL STUDY OF THE DOSE DISTRIBUTION IN WATER AROUND ^{137}Cs TUBES USED IN BRACHYTHERAPY. Klevenhagen, S. C. (London Hospital). Brit. J. Radiol.; 46: No. 552, 1073-1082(Dec 1973).

The dose distribution in water around type CDC.G^{137}Cs tubes (Radiochemical Centre, Amersham) was measured by means of a silicon surface barrier p–n junction detector (for relative values) and a small ionization chamber (for absolute values). The cylindrical semiconductor detector, of 3 mm outer diameter, had high sensitivity, good spatial resolution, and satisfactory energy dependence for measurements of a relative nature. Thirty

cesium tubes were investigated; all showed dose distributions symmetrical about the longitudinal axis of the source but asymmetrical about the lateral axis, the latter effect varying in detail from source to source. The distribution for a "typical" cesium source was obtained by averaging the data of ten sources with different distribution patterns. The absolute dose rates and distributions of ^{137}Cs and radium tubes of similar size, equal activity, and identical screenage (0.5 mm Ir–Pt) were compared. By matching the dose rates on the lateral axis (the cesium dose rates are actually about 2.8 per cent higher because of a different water/air ratio) the isodose curves were shown to be similar in shape, although some differences amounting to a few per cent in terms of dose rate were observed on the longitudinal axis and in the paraxial region. The clinical radium tubes have a screenage of 1 mm Ir–Pt and this decreases the dose rate at all depths on the lateral axis by 9.7 per cent relative to the clinical cesium tubes, with corresponding changes in the distribution as a whole. The uncertainties involved in the measurements have been assessed and the overall most probable error on the lateral axis found to be 3.7 per cent. (auth)

17463 SPECTRUM MEASUREMENTS IN 15 MeV NEUTRON THERAPY BEAMS. Hannan, W. J.; Porter, D.; Lawson, R. C.; Railton, R. (Western Regional Hospital Board, Glasgow). Phys. Med. Biol.; 18: No. 6, 808-820(Nov 1973).

Energy spectra in collimated DT neutron beams have been investigated using an organic scintillator proton recoil spectrometer incorporating pulse shape discrimination against γ-rays. Measurements covered the energy range 0.5 to 15 MeV. A Monte Carlo program was used to generate corrections for α-particles produced by neutron interactions with the carbon atoms of the scintillator which affect the spectrum below 3.5 MeV neutron energy. The influence of collimator shape and composition was investigated in geometry which simulated therapy conditions. The variations in spectrum quality were determined along the central axis and in a penumbra region in a tissue-equivalent phantom. The results are discussed with reference to DT neutron therapy. (auth)

17464 ALGORITHM FOR CALCULATION OF THE RADIATION TRANSPORT THROUGH INHOMOGENEOUS MEDIA. Umiastowski, K. Nukleonika; 18: No. 6, 273-276(1973).

A Monte-Carlo algorithm for calculating the history of the quantum in inhomogeneous medium is presented. Inhomogeneous medium consists of the continuously distributed matrix, in which spherically shaped grains are randomly distributed. (auth)

17465 RANGES OF ^{99}Mo AND ^{140}Ba IN SEVERAL STOPPING MEDIA FROM THE SPONTANEOUS FISSION OF ^{252}Cf. Izmen, A.; Birgul, O.; Aras, N. K. (Middle East Tech. Univ., Ankara). J. Inorg. Nucl. Chem.; 36: No. 1, 25-29(Jan 1973).

The average ranges of ^{99}Mo and ^{140}Ba in aluminium, nickel, copper and palladium (^{140}Ba only) were measured from the spontaneous fission of ^{252}Cf. The average ranges of ^{99}Mo and ^{140}Ba are respectively: mg Al/cm^2: 3.85 ± 0.05, 3.03 ± 0.03, mg Ni/cm^2: 5.53 ± 0.22, 4.45 ± 0.10, mg Cu/cm^2: 6.07 ± 0.17, 4.97 ± 0.16, mg Pd/cm^2: 5.81 ± 0.08 (^{140}Ba). The measured ranges were compared with calculated ranges from kinetic energies using the modified LSS equation (Lindhard et al., K danske Vidensk. Mat. Fys. Medd.; 33: No. 14(1963)). A general range-energy equation is proposed, applicable to most fissioning systems and stopping media. (auth)

17466 DOSE DISTRIBUTION DUE TO NEUTRONS AND PHOTONS RESULTING FROM NEGATIVE PION CAPTURE IN TISSUE. Schillaci, M. E.; Roeder, D. L. (Los Alamos Scientific Lab., NM). Phys. Med. Biol.; 18: No. 6, 821-829(Nov 1973).

The dose distributions due to neutrons and photons produced when negative pions are used in radiotherapy were calculated using a Monte Carlo transport program. The simple model used for this calculation assumed a spherical, uniform stopping region centred within a sphere of tissue. Treatment volumes of 0.01, 0.1 and 1 litre were used, representing a range of tumour sizes. The photon dose was found to be negligible in comparison with the neutron dose. Curves for the neutron dose as a function of radius within the sphere of tissue are presented. The average doses delivered outside of the treatment volumes ranged from 0.012% to 0.91% of the total treatment doses. It is concluded that the secondary dose to nearby organs due to neutrons produced in pion "stars" will not severely limit the utility of pion radiotherapy; however, vital structures located adjacent to large treatment volumes could receive significant doses. (auth)

17467 SPECTRA OF CHARACTERISTIC ENERGY LOSS BY ELECTRONS IN TRANSITION METALS OF THE YTTRIUM–PALLADIUM SERIES. Korsunskii, M. I.; Genkin, Ya. E.; Muzychuk, R. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 6-13(1972). (In Russian).

The characteristic energy loss by electrons during reflection from massive samples of Y–Pd series metals was calculated, on the premise that the most probable types of such energy loss in the kilovolt range were one type of energy loss as surface excitation and three types as solid (three-dimensional) excitation. The parameters of the first inelastic peaks of all four types of energy loss were determined, with consequent agreement of the calculated spectra with the experimental. Energy loss at the surface of a sample is associated with the excitation of surface plasmons. The first and second types of energy loss are connected with excitations of the plasma of collectivized electrons and with collective excitations of locally bound electrons, respectively. The authenticity and nature of the third type of solid excitation are discussed. (tr-auth)

17468 CALCULATION OF THE DEGRADATION SPECTRUM OF FAST ELECTRONS IN AN INFINITE UNIFORM MEDIUM. Kaplan, I. G.; Popova, L. V.; Khadzhibekova, L. M. (Physical Technical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 3, 214-218(1973).

Translated from Khim. Vys. Energ.; 7: No. 3, 241-245(1973).

The degradation spectrum of a monochromatic beam of electrons having an energy of 10 keV in water was calculated by means of the Monte Carlo method. The energy lost by an electron during excitation and ionization of water was taken into account. The classical cross section of Stabler was taken as the interaction cross section. The energy spectra of the secondary and tertiary electrons and also the degradation spectra of the electrons of all subsequent generations were derived. (auth)

17469 ANGULAR DEPENDENCE OF THE COMPONENTS OF DOSE TO THE BONE MARROW AND ABDOMEN IN A HUMAN PHANTOM FROM 2.95-MeV Neutrons. Facey, R. A.; Clifford, C. E. (Defense Research Establishment, Ottawa). Health Phys.; 25: No. 6, 545-557(Dec 1973).

Gamma and recoil-ion dose measurements were carried out in a human-shaped phantom exposed to whole-body monoenergetic neutrons at 2.95 MeV. For the γ component miniature, energy-compensated, thermoluminescent dosimeters of CaF_2:Dy were used inside bones to measure the bone-marrow dose. For abdominal dose and surface dose, a small Geiger chamber was used to supplement the TL system. Proportional counters were used for the recoil-ion measurements. The dose components were measured as a function of both the angle of phantom rotation and the angle of elevation of the incident radiation. The significance of the γ component of the fast-neutron dose is discussed, and it is shown to be of particular importance with respect to incident neutron energies of 3 MeV and below, to off-normal angles of irradiation, and to the low values of the quality factors required for acute effects of radiation dose. Internal recoil-ion dose may be predicted within a factor of two from calculations. The study shows the very large effect due to the angle of incidence of the neutron radiation, and it suggests that the chest is an unsuitable badge location for practical accident dosimetry. (auth)

17470 CALCULATION OF PROPORTIONAL COUNTER ENERGY DEPOSITION SPECTRA FROM EXPERIMENTAL DATA. II. Very Small Energy Losses and High Energy Delta Rays. Baily, N. A.; Steigerwalt, J. E. (Univ. of California, San Diego, La Jolla). Radiat. Res.; 56: No. 2, 213-221(Nov 1973).

It is shown that a convolution technique, developed by Kellerer can be used to generate energy deposition spectra, by either forward or reverse shifts, for many pathlengths from a limited set of experimental data for low energy fast protons (~45 MeV) corresponding to pathlengths of radiobiological interest. For medium energy fast protons (~600 MeV) the method fails if shifts based upon the expected average energy losses are used as the base for these calculations. However, if shifts based on an experimental determination of the average energy loss in the volume of interest are used then good agreement with experiment is obtained. This reflects the effect of energy transport into and out of the counter volume by high energy secondary particles, resulting in a significant loss of energy from the volumes in which the measurements have been made and the high probability for a significant number of incident particles not undergoing collisions over the test pathlength. This results in experimental values of average energy which are different than those calculated using stopping power theory. (auth)

17471 EVALUATION OF THE RANGES OF FISSION PRODUCTS. Rustichelli, F. (EURATOM, Ispra, Italy). pp 559-573 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343 (Vol. 1); CONF-730302-(Vol. 1).

By using the theory of Lindhard, Scharff, and Schioett and available experimental data for average ranges in a few stopping elements, a complete set of ranges in all the natural elements for the median-light, median-heavy, and overall median ^{235}U fission fragments has been derived. A similar approach was used in the present paper to derive the corresponding quantities for thermal-neutron-induced ^{239}Pu fission. By using the theory of Lindhard, Scharff, and Schioett and the few data existing for ^{239}Pu fission fragment ranges in air and Al, a complete set of average ranges of ^{239}Pu fission fragments in all the existing natural elements was obtained. This set includes, for each stopping element, ranges for the median-light, median-heavy, and overall median fission fragments. The method of fission product evaluation used is quite general, and is being extended to the other fissile nuclei of interest. (4 figures, 2 tables) (auth)

17472 TRANSPORT OF NEUTRONS INDUCED BY 800-MeV PROTONS. Fluharty, R. G.; Seeger, P. A.; Harris, D. R.; Koelling, J. J.; Deutsch, O. L. (Los Alamos Scientific Lab., NM). pp 607-619 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

Neutron transport calculations are presented for a pulsed neutron and proton research (Weapons Neutron Research, WNR) facility. Pulses of 800-MeV protons are obtained from the Los Alamos Meson Physics Facility (LAMPF) of 5 to 10 μs duration or 1 to 2% of the full LAMPF beam, this beam yielding a maximum average neutron source strength of (1 to 2) $\times 10^{15}$ neutrons/s. The calculated shield required to reduce this source to ~1 mrad/h consists of 2.6 m of steel plus 0.4 m of magnetite concrete and boron glass frit. The vertical proton beam and target require special consideration of the underground shielding to reduce floor dosage. Neutron source, energy deposition, and activation calculations are based on two continuous-energy Monte-Carlo codes. NMTC and MCN, adapted to CDC 6600 and CDC 7600 computers. The NMTC code contains the detailed Monte-Carlo intranuclear-cascade calculations of Bertini. To maintain adequate statistical accuracy for deep penetration, a series of problems is run in which leakage neutrons from the previous problem are weighted and split as a source for the new problem containing added material. The low-energy MCN calculations, which use standard cross-section sets for energies below 20 MeV, are included in the last 1.2 m of thickness. To provide more efficient calculational methods, a parallel effort was undertaken to generate multigroup cross-section sets by using the intranuclear-cascade model. An advantage of this method is that experimental values can also be incorporated. A library was so constructed for iron and nine other elements, in a format for combination with ENDF libraries, for ten energy groups from 20 to 800 MeV. Comparison tests were made on a spherical problem with a 1-m void followed by 2 m of iron. The multigroup Monte-Carlo program ANDY-MGCR, with source weighting and surface splitting, agrees with the SN transport code DTF-IV; however, the DTF results are only 60% of the results of the NMTC method described above. Since the difference is a relaxation-length effect, it probably reflects the inadequacy of the P_3 cross-section expansion tested to date. In addition to testing with higher-order cross-section sets, plans include experimental tests of thick iron shields. (8 figures, 1 table) (auth)

17473 NUCLEAR DATA COMPILATIONS OF UTILITY IN MEDICAL AND BIOLOGICAL APPLICATIONS. Dillman, L. T. (Ohio Wesleyan Univ., Delaware); Snyder, W. S.; Ford, M. R. pp 529-539 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 2); CONF-730302-(Vol. 2).

Detailed knowledge concerning the energies and intensities of all the radiations emitted as a result of a radioactive decay process is necessary in making radiation dose calculations. The principal author has previously published a compilation of nuclear data of this type for nuclides of interest in medical and biological applications. This paper reports on significant extensions of that work. The bremsstrahlung spectrum associated with beta particles and with monoenergetic conversion electrons was recently calculated. Although only the inner bremsstrahlung is an invariable part of the radioactive decay process, the external bremsstrahlung in addition was calculated for absorption in air, muscle, adipose tissue, and skeleton. As a further aid to persons involved in internal radiation dose calculations, it is proposed to use decay scheme data as input and calculate specific effective energies (SEE) for many radionuclides. Specific effective energy is the energy absorbed per gram of target organ Y for each disintegration of the radionuclide in source organ X multiplied by qualifying factors associated with linear energy transfer values of the radiation. A computer program was written which calculates SEE values for a large matrix of target and source organs. For each radiation, in addition to the intensity and energy, this program interpolates from a table to find the fraction of the energy absorbed in organ Y for a source uniformly distributed in organ X. These absorbed fractions were determined by Monte-Carlo techniques by using a nonhomogeneous phantom representing standard man. The quality factors used in all calculations are shown explicitly so that the SEE tables may be used in calculations of absorbed dose as well as dose equivalent. All of the nuclear data and the static biological data are provided in the SEE tables, with the kinetic biological data which the user must provide being contained in the residence time of the radionuclide in the source organ. (1 figure, 3 tables) (auth)

17474 PRACTICAL ASPECTS OF NEUTRON DOSIMETRY IN BIOLOGY AND MEDICINE. Broerse, J. J. (Radiobiological Inst. TNO, Rijkswijk, Netherlands). J. Belge Radiol.; 56: No. 5, 431-434(1973).

A number of practical aspects of neutron dosimetry in biology and medicine are discussed; in particular: the variations of absorbed dose at interfaces of materials of different atomic composition, experimental techniques employed to determine the kerma in soft tissue, measurements of the distribution of absorbed dose due to neutrons and gamma rays in tissue equivalent phantoms. (auth)

17475 CONTROL OF ACCURACY OF CENTERING IN RADIATION THERAPY. Mil'shtein, R. S. (Scientific-Research Inst. of Roentgenology and Radiology, Moscow). Med. Radiol.; 18: No. 10, 45-48(Oct 1973). (In Russian).

The methods of control over centering accuracy are described based on coincidence by corresponding labels of usual roentgenograms with those exposed to a therapeutic beam, or with the film on which the contours of the field of irradiation are determined by induced activity. (auth)

17476 INFLUENCE OF THE NATURE OF THE SUPPORT ON THE DOSE NEAR THE INTERFACE DURING IRRADIATION WITH SOFT X RAYS. van Caneghem, P.; Vanherle, R. (Univ., Liege). Strahlentherapie; 146: No. 3, 345-351(Sep 1973). (In German).

In order to confirm previous dosimetric studies, physical and chemical ones, on the intensity of secondary radiation emitted on the surface of a material (backscatter) in connection with its composition (effective atomic number), we have used as a biological reagent the intensity of light emission by Photobacterium phosphoreum. The decrease of luminescence and, therefore, the secondary radiation in an aqueous medium is smaller when it is placed above the surface of a material equivalent to bone tissue than above an equivalent to soft tissue, if irradiated with very soft x rays (about 10 keV equiv.). Attention is drawn to the advantage of such radiation in superficial radiotherapy. (auth)

17477 CALCULATION OF DOSE DISTRIBUTION THROUGH GAUZE FILTERS WITH THE AID OF A COMPUTER. Krongauz, A. N.; Nguen Van Tkhien; Pavlova, T. G.; Shagimardanov, N. Sh. (Scientific Research Inst. of Roentgenology and Radiology, Moscow). Med. Radiol.; 18: No. 10, 52-55(Oct 1973). (In Russian).

On the basis of experimental data the analytical expression for calculation of dose distributions through gauze filters was derived. Calculations were made on a computer and the data of calculations were compared with experimental materials. (auth)

17478 SUBCUTANEOUS BETA DOSE RATE FROM FISSION PRODUCTS DEPOSITED ON THE SKIN. O'Brien, K. (Atomic Energy Commission, New York). Health Phys.; 26: No. 1, 122-127(Jan 1974).

The predictions of Loevinger's (Radiation Dosimetry. Academic Press. New York (1956)) formula and transport theory in respect to exponential absorption are compared. The dose rates to the skin are calculated from a plane source both under infinite medium conditions, that is with the source in finite tissue, and under finite medium conditions, that is with the source on the surface of the skin. The transport calculations for an infinite medium are compared with Loevinger's formula as a test of the validity of the one-group approach. The finite medium transport calculations are compared both with infinite medium results and with Osanov et al.'s results (Health Phys.; 17: 489 (1969)). (UK)

Radiation Protection Standards

Refer also to abstracts 15965, 15977, 15979, 17943, and 17944.

17479 (INIS-mf-582) FUNDAMENTAL BASES OF RADIOLOGICAL PROTECTION. Sowby, F. D. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 12p. INIS.

The first practical measures in radiation protection were instituted within a few decades after the discovery of x rays and radium. These culminated, in 1928, in the establishment of the International Commission on Radiological Protection. The paper reviews the development of the maximum permissible doses recommended by ICRP during the past forty years, and compares the present levels with the doses actually being received. Particular emphasis is given to the exposures resulting from the use of nuclear power. Today's recommended dose limits are the results of a process of modifying levels over a period of forty years, and it is therefore not surprising that the present system of permissible levels is not quite internally consistent. Theoretically a consistent set of levels could be devised, if enough were known about the risks of low doses. The paper attempts to assess the upper limits of the risks of the current dose limits, and to compare these with the known risks to which people are exposed, either in their work or as members of the general public. (auth)

17480 OSNOVNYE SANITARNYE PRAVILA RABOTY S RADIOAKTIVNYMI VESHCHESTVAMI I DRUGIMI ISTOCHNIKAMI IONIZIRUYUSHCHIKH IZLUCHENII OSP-72. (Basic Sanitary Rules for Working With Radioactive Substances and Other Sources of Ionizing Radiation). Kulyamin, V. A. (ed.). Moscow; Atomizdat (1973). 55p. (In Russian).

This is a replacement for and expanded version of an earlier book with a similar title. (tr-auth)

17481 INDUSTRIAL SAFETY PROGRAM IN THE MEXICAN NUCLEAR CENTER. Martinez Pardo, M. E. Veracruz, N. Mex.; Instituto Tecnologico Regional de Veracruz (1973). 77p. (In Spanish).

Thesis.

The safety conditions and needs existing in each work area of the Nuclear Center were determined. These conditions and needs were obtained during the development of an industrial hygiene and safety program. The program is critically examined to see if it is adequate from the industrial hygiene viewpoint. (JSR)

17482 DESIGN TESTING OF X-RAY EMITTERS, HIGHLY AND FULLY PROTECTED EQUIPMENT AND RADIATION PROTECTION TESTING OF NON-MEDICAL X-RAY INSTALLATIONS. Kolb, W. (Physikalisch-Technische Bundesanstalt, Brunswick). Arbeitsschutz (Cologne); No. 4, 169-172(1973). (In German).

The regulations on the design testing according to Paragraph 7.1 of the new ordinance and the procedure for radiation protection testing according to Paragraph 4.1 are discussed. (GE)

17483 NEEDED CHANGES IN RADIATION PROTECTION STANDARDS. Blatz, H. Health Phys.; 26: No. 1, 127-128(Jan 1974).

Two things should be kept in mind in writing general radiation regulations. One is that the most needed and the most profitable regulations to enforce (in terms of reducing the population dose) are those related to the medical and dental use of x rays. The other is that the occasion during which the simplicity and clarity of the wording may permit the understanding of a rule by someone who must follow it, is infinitely more frequent than the rare case when legally precise language will help the successful prosecution of a violator. Parts of regulations that have been particularly troublesome in the past and which it is suggested should be made realistic are given. Changes are proposed for consideration and comment. (UK)

Radiation Source Calibration and Standardization

17484 EFFECT OF A PLANE BOUNDARY ON THE DOSE DISTRIBUTION OF BETA RADIATION INSIDE A THICK SOURCE. Osanov, D. P.; Podsevalov, Yu. N. At. Energ. (USSR); 35: No. 1, 49-50(Jul 1973). (In Russian).

This study presents an equation for calculating the dose distribution within and on the surface of a thick-layer, plane, tissue-thin source with a given unidimensional distribution of radioactive material. In the experiment use was made of an extrapolation chamber. The collecting electrode of the chamber had a window covered with a thin aluminized dacron window. Seven different isotopes with energies varying from 0.43 MeV (^{185}W) to 3.55 MeV (^{106}Ru) were used in preparing the activity sources. From an analysis of the experimental data a function is derived from which it is possible to calculate the beta dose with an error of <5%. (SJR)

17485 METHOD OF CALIBRATION FOR LOW ENERGY X-RAY BEAMS. Nunnally, J. E. (Univ. of Texas, Dallas). Phys. Med. Biol.; 18: No. 6, 878-880(Nov 1973).

It is pointed out that the measurement of very soft x-ray beams with conventional thimble ionization chambers can be very difficult because of extremely high exposure rates. Simple inverse square calculations do not suffice, even if the x-ray target is small, because of significant attenuation by air. A method of calculating exposure rates is described, which is based on the inverse square law, but in which account is taken of the attenuation due to air. The method avoids the plotting and reading errors associated with graphical extrapolation methods. A specimen calculation for a 100 Kv beryllium-windowed x-ray tube is given. (auth)

17486 STATUS OF DOSIMETRY FOR ^{252}Cf MEDICAL NEUTRON SOURCES. Anderson, L. L. (Sloan-Kettering Inst. for Cancer Research, New York). Phys. Med. Biol.; 18: No. 6, 779-799(Nov 1973).

A critical review is made of the available dosimetric data on ^{252}Cf medical neutron sources, with relation to possible explanations of existing disparities and to recommend a method of arriving at a set of "best values". An attempt has been made to indicate the effect on the data of charges in irradiation parameters such as tissue composition, depth in tissue and source encapsulation. (UK)

17487 STANDARDIZATION METHOD FOR ^{110m}Ag. Brinkman, G. A. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Int. J. Appl. Radiat. Isotop.; 24: No. 11, 649-651(Nov 1973).

A method of standardizing ^{110m}Ag, using the "sumpeak" technique, is described. A simplified decay scheme for ^{110m}Ag, which disregards all γ-rays with an abundance <1%, is given. An equation is derived for the determination of the absolute activity by the sum-peak method. The result of a calibration using this method is compared with that obtained using a Ge-Li crystal comparing the 658 keV γ-ray with the 662 keV γ-rays of three standard ^{137}Cs sources. (UK)

17488 INTEGRITY AND TEST SPECIFICATIONS FOR SELECTED BRACHYTHERAPY SOURCES. New York; American National Standards Institute, Inc. (1973). 10p. (ANSI-N44.1-1973).

This standard establishes integrity requirements and test specifications for selected sealed medical sources used in interstitial, intracavitary, and topical therapy (commonly referred to as brachytherapy). The standard is limited to the traditional types of sources with well-established medical uses and does not provide criteria for sources used in afterloaded devices. The three categories of sources covered by the standard are "tubes or capsules" and "needles" containing ^{226}Ra, ^{60}Co, or ^{137}Cs, and "beta applicators" containing either ^{90}Sr or ^{226}Ra. The standard establishes performance test specifications for temperature, impact, percussion, bending, tensile stress, and puncture. All source types must pass the temperature, impact, and percussion tests, which are the same test for classification of a source as "special form" under the transportation regulations of the Department of Transportation and the International Atomic Energy Agency. In addition, the bending test is required for "interstitial needles" and the tensile stress and puncture test for the "beta applicators." A source is deemed to pass the test if it is "free of visual defects" and "demonstrates leakage of less than 50 nCi (10 nCi of radon in 24 hours in the case of ^{226}Ra sources)." The standard also requires a quality-control program "to insure that the production units will have the same integrity and meet the same requirements as the production units tested pursuant to this standard." The quality-control program further requires that each source before transfer be tested for and demonstrate leakage of less than 5 nCi (1 nCi of radon in 24 hours in the case of ^{226}Ra sources). (auth)

Shielding Calculations and Experiments

Refer also to abstracts 17472, 17575, and 17664.

17489 CLASSIFICATION OF SHIELDING CONCRETES ACCORDING TO ELEMENTS CONTAINED. Draft. Cologne; Beuth (1973). vp. (In German).

This draft standard does not lay down rules for the composition of real concretes, but establishes significant values of elements contained in typical shielding concretes for design calculations.(GE)

17490 LEAD SHOT AS A MEANS OF SHIELDING IN X-RAY THERAPY. Werner, A.; Har-Kedar, J.; Chaitchik, S.; Brenner, H. J. (Sheba Medical Center, Tel Hashomer, Israel). pp 16-27 of Proceedings of the 6th National Conference of the Israel Health Physics Society. Schlesinger, T. (ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From 6th national conference of the Israel Health Physics Society; Nahal Soreq, Israel (19 Dec 1971).

Accurate, reproducible, and shaped shielding is an absolute requirement in modern radiotherapy. A method that does not involve heavy equipment is presented. Lead shot is placed in a styro-foam block hollowed to the required shape with a simple hot wire cutter. It reproduces the shadow cast by the irradiating beam and thus the organ to be shielded is geometrically reproduced and accurately shaped. The check films need to be taken at a higher FSD than the treatment distances to allow for cobalt source size. The lead shot need not be of any particular size provided the diameter is small compared to the shape required. This method has already given improved results, as it has fewer side effects and is easier to use. (INIS)

17491 SHIELDING AGAINST THE NEUTRONS PRODUCED WHEN 400-MeV ELECTRONS ARE INCIDENT ON A THICK COPPER TARGET. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., TN). Particle Accel.; 5: No. 3, 155-159(1973).

Neutron-transport calculations have been carried out using the method of discrete ordinates, and the dose equivalent as a function of radius in spherical shields of various compositions is presented. The incident-neutron spectra used are characteristic of the spectra emitted in the angular intervals of 0 to 30°, 30 to 60°, 60 to 120°, and 120 to 180° when 400-MeV electrons are incident on a thick copper target. Results are given for shields of soil, concrete, ilmenite, iron, and iron followed by soil. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 16859, 17328, and 17382.

17492 INFINITE PRODUCTS OF RANDOM ELEMENTS ON COMPACT TOPOLOGICAL SEMIGROUPS. Byczkowski, T. (Univ., Wroclaw). Zesz. Nauk. Uniw. Jagiellon., Pr. Fiz.; 21: No. 8, 735-740(1973).

Infinite products of independent random elements on a compact topological semigroup S are considered and under some additional assumptions the equivalence of different sorts of convergence of such products is proven. Using the above results a characterization of the sequences of independent random elements and composition convergent sequences on S with convergence product of variances is given. (auth)

17493 FACTORS OF TYPE II AND QUANTUM MECHANICS. Bjoernestad, O. (Univ. of Western Australia, Perth). Helv. Phys. Acta; 46: No. 3, 371-387(1973).

It is shown that a self-adjoint operator in a separable Hilbert space can be affiliated to a factor of type II if and only if "its spectrum is of infinite multiplicity." This result is then put on a form suitable for application, and an example is given. (auth)

17494 TRACE OF THE PRODUCT OF DIRAC MATRICES OCCURRING AS $A' = A[\gamma_1 + iA]_5$. Sarkar, S. (Indian Association for the Cultivation of Science, Jadavpur, Calcutta). Acta Phys. Acad. Sci. Hung.; 34: No. 1, 13-23(1973).

Several methods are given for evaluating the trace of the product of an arbitrary number of elements A'_r which involve Dirac matrices in the manner $A'_r = A'_{i_r}\gamma_1 + iA'_{i_r}$. Formulas for the determination of expressions of the type trace $(\gamma_{i_1}\gamma_{i_2} \ldots \gamma_{i_n}A'_1A'_2)$ trace $(\gamma_{i_1}\gamma_{i_2} \ldots \gamma_{i_n}B'_1B'_2 \ldots B'_m)$ are obtained. The above problems with γ_5 also occurring in the traces are dealt with, and some useful identities involving Dirac matrices are established. (auth)

17495 RELATIVISTIC DYNAMICS. Horwitz, L. P. Piron, C. (Univ., Geneva). Helv. Phys. Acta; 46: No. 3, 316-326(1973).

A canonical formalism for the relativistic classical mechanics of many particles is constructed. The correct equations for the motion of a charged particle in an electromagnetic field are obtained in this formalism, and the relativistic two-body problem with an invariant interaction is solved by showing that there is a special frame in which the equations of motion are essentially the same as those for the nonrelativistic theory. The classical canonical formalism is then used as a basis for the construction, by means of the correspondence principle, of a consistent relativistic quantum theory. A simple interpretation is provided for the Newton-Wigner position operator by showing that it is just the observable $\vec{q} - \frac{1}{2}[(\vec{p}/E)t + t(\vec{p}/E)]$ in a representation, called the mass representation, which diagonalizes the momentum and the free particle "Schrödinger operator". (auth)

17496 NON-SINGULAR GENERALIZED DYNAMICAL FORMALISMS. Ruggeri, G. J. (Univ. of Central Venezuela, Caracas). Int. J. Theor. Phys.; 8: No. 4, 253-262(1973).

It is shown that a certain class of classical dynamical formalisms, characterized by nonsingular Lie structures more general than the usual (Poisson) one, are derivable from ordinary constrained dynamical formalisms. As a consequence, the Lie brackets considered are special cases of suitably chosen Dirac brackets. Both unconstrained and constrained generalized dynamical formalisms are considered. The relations of these results with the problem of constructing classical analogs of generalized quantum systems are stressed. (auth)

17497 SOME REMARKS ON WIGNER DISTRIBUTION. Berezin, F. A. (Moscow State Univ.). Teor. Mat. Fiz.; 17: No. 3, 305-318(Dec 1973). (In Russian).

The following formula was obtained for generalized Wigner ensemble of random N-order matrices $A_N(\omega)$

$$\lim_{N\to\infty}\frac{1}{N}\ln\int \det A_N(\omega)d\omega = \lim_{N\to\infty}\frac{1}{N}\int \ln\det A_N(\omega)d\omega.$$

This formula means strong selfaveraging of $[\det A_N(\omega)]^{1/N}$. In addition, it enables one to apply the integral over anticommuting variables to the calculation of limit distribution. It turns out that the Hartree-Fock approximation for this integral gives an exact value when $N \to \infty$. (auth)

17498 SOLUTION OF THE DIRAC EQUATION FOR SCALAR POTENTIALS AND ITS IMPLICATIONS IN ATOMIC PHYSICS. Soff, G.; Mueller, B.; Rafelski, J.; Greiner, W. (Univ., Frankfurt am Main). Z. Naturforsch., a; 28a: No. 9, 1389-1396(1973).

The Dirac equation is solved for mixed vector-scalar potentials. The limits on the scalar coupling constant are set by precision atomic experiments. The maximal size of the scalar coupling constant $\alpha' = 2.5 \times 10^{-8}$ per charge unit is obtained. Deviations from the Mott scattering are also determined. (auth)

17499 SELF-CONTRADICTORY FOUNDATIONS OF FORMALISTIC QUANTUM MEASUREMENT THEORIES. Park, J. L. (Washington State Univ., Pullman). Int. J. Theor. Phys.; 8: No. 3, 211-218(1973).

One school of thought in quantum measurement theory adopts as its aim the derivation of a certain mixed statistical operator to characterize the ensemble of global object-apparatus systems subsequent to the measurement interaction. It is demonstrated that even if that goal were achieved, the consequent theory of measurement would be self-contradictory; hence the measurement problem is improperly formulated. The epistemological root of the difficulty is discussed briefly. A logical resolution is offered in terms of quantum axiomatics by emphasizing the actual relation of quantum theory to experimental and observational data. (auth)

17500 GAUGE-VARIANCE OF THE DIRAC BRACKET. Kalnay, A. J. (Instituto Venezolano de Investigaciones Cientificas, Caracas); Ruggeri, G. J. Int. J. Theor. Phys.; 8: No. 3, 189-198(1973).

A study is made of the change in the functional form of the minus Dirac bracket under pure gauge transformations (in the sense of Levy-Leblond (Communications in Mathematical Physics; 12: 64 (1969)). A closed formula was found which expresses this change and it is used to discuss the relevance of a gauge transformation for the skew-symmetric (Bose-like) quantization procedure of constrained classical models. The necessary conditions which are to be fulfilled if the gauge transformation is to induce a mere change of representation at the quantum level was found. It is shown, by considering a simple example, that these conditions can be violated. It is concluded that adding a total time derivative to the Lagrangian of a classical model can drastically change the physical properties of the quantized Bose-like counterpart. A similar result has been detected previously for two particular systems quantized through the symmetric (Fermi-like) rule of quantization. (auth)

Quantum Field Theories

Refer also to abstracts 16942, 16980, 16986, 16998, 16999, 17526, and 17535.

17501 (ORO-3992-157) COVARIANT THEORY OF MAGNETIC MONOPOLE. Chiang, C. C. (Texas Univ., Austin (USA). Center For Particle Theory). 1973. 16p. (CPT-201). Dep. NTIS $3.00.

In the local quantum field theory of magnetic monopole proposed by Hagen, not all of the equations of motion are covariant under the Lorentz transformation. It is shown that with the introduction of a shadow electromagnetic field quantized with "wrong sign," the locality in the sense of local commutation relations and local equations of motion is still retained, while the equations of motion become covariant under the Lorentz transformation. (auth)

17502 (ORO-3992-158) THEORY OF MASSIVE AND MASSLESS YANG-MILLS FIELDS. Hsu, J. P.; Sudarshan, E. C. G. (Texas Univ., Austin (USA). Center For Particle Theory). 1973. 16p. (CPT-202). Dep. NTIS $3.00.

Introducing the Lagrangian multiplier field $\vec{\chi}(x)$, a canonical formalism for the Yang-Mills fields $\vec{f}_\mu(x)$ with mass $M \geq 0$ is proposed within the framework of an indefinite metric quantum field theory. The formalism for the massive $\vec{f}_\mu$ has a well-defined zero mass limit and the reduction of the physical components of $\vec{f}_\mu$ as $M \to 0$ is embodied in an elegant way. Using the field equation for $\vec{\chi}(x)$ and the path integral, it is found that the "extra" amplitude due to the interaction of $\vec{\chi}(x)$ in the intermediate states is $[\det(1+(O + M^2)^{-1} g\vec{f}_\mu \times \partial^\mu)]^{-\frac{1}{2}} \equiv D_M^{\frac{1}{2}}$ for the massive $\vec{f}_\mu$, and that the extra amplitude is $D_{M=0}^{\frac{1}{2}}$ for the massless $\vec{f}_\mu$ because of their different degrees of observable freedom. Thus, the resultant rules for the Feynman diagrams for $M > 0$ and $M = 0$ are not smoothly connected. The theory is covariant, renormalizable and unitary after the extra parts are removed from the amplitudes. The problems of unitarization and renormalizability are discussed. (auth)

17503 MOTION OF AN ELECTRIC DIPOLE IN AN EINSTEINIAN UNITARY FIELD. Cariboni, M. Rend. Ist. Lombardo Sci. Lett., A; 106: No. 3, 564-583(1972). (In Italian).

Derivation of the law of motion of an electric dipole associated with two preferential directions from Einstein's last unitary theory. The problem is treated for the case where the electrostatic potential depends not only on the colatitude but also on the longitude of the potentiated point in a polar coordinate system with its origin on the potentiating dipole and its polar axis being that of the dipole. Using an integral formula derived by Clauser (1956), the law of motion is obtained in the first approximation, and, in addition to gravitational, Coulomb, and interaction forces, other forces which depend on the preferential directions associated with each particle are determined. (IAA)

17504 INTERPRETATION OF THE GENERALIZED FREE FIELD IN TERMS OF STABLE PARTICLES AND PARAPARTICLES. Turko, L. (Univ., Wroclaw). Acta Univ. Wratislaviensis; 2: No. 164, 168-181(1972).

It is pointed out that a conclusion by L. Streit who has shown that a generalized free field can be constructed as an operator on a Fock space of an ordinary free field, is incorrect because of a structure of the generalized free field which makes an action of the generalized free field in a Fock space of an ordinary free field impossible. (JFP)

17505 CLASSICAL LIMIT OF QUANTUM THEORIES. Bialynicki-Birula, I. (Univ., Warsaw). Acta Univ. Wratislaviensis; 2: No. 164, 33-43(1972).

A lecture is given on the correspondence between quantum and classical theories. The noveity lies in the systematic use of coherent states which enable one to discuss quantitatively the transition from quantum to classical theories for particles and for fields as well. (JFP)

17506 NONSTATIC SOLUTION OF THE ALREADY-UNIFIED FIELD. Gopala Rao, A. V. (Univ. of Mysore, India). Indian J. Pure Appl. Phys.; 11: No. 5, 351(May 1973).

A nonstatic cosmological solution of the equations of Rainich's already unified field theory is presented. The solution represents the geometry of an electromagnetic field with a removable gravitational field in the background. (auth)

17507 QUANTIZATION OF THE MAXWELL FIELD WITH THREE POLARIZATION DIRECTIONS. Schmutzer, E. (Univ., Jena, Ger.). Acta Phys. Acad. Sci. Hung.; 34: No. 1, 25-40(1973).

The unsatisfactory situation of the well known quantization procedures of the Maxwell field (Coulomb gauge, Fock–Podolsky method, Gupta–Bleuler formalism) has been stressed in the last years, and a considerable number of new proposals have been made. Joining the idea of Novobátzky and Valatin, that the Maxwell field possesses only three polarization degrees of freedom, a form of quantum electrodynamics with full use of the Lorentz condition is presented. The resulting commutation relations correspond with those of Valatin; the Hilbert space, as far as it was investigated, proves to be of definite metric. Some results have already been published. (auth)

17508 STATISTICAL PHYSICS AND QUANTUM FIELD THEORY. Bogolyubov, N. N. Moscow; Izdatel'stvo Nauka (1973). 457p. (In Russian).

Topics discussed include the use of so-called quasi-averages (or statistical averages with broken symmetry) in problems involving degeneration of statistical states; the use of quasi-averages in the theory of irreversible processes; the present state of the method of two-time Green's functions in the quantum theory of magnetism; the use of two-time Green's functions to calculate the high frequency susceptibility of Heisenberg spin systems; the use of these functions in problems related to the elementary excitation spectrum of a nonideal Bose gas, in problems involving strongly anharmonic crystals, and in a study of the Ising model; the calculation of the thermodynamic and electromagnetic properties of pure superconductors with two overlapping energy bands; thermodynamic processes related to the measurement of spin temperatures in nuclear and electronic spin systems; the electronic theory of unordered systems; and the use of the theory of many complex variables and the theory of generalized functions in axiomatic quantum field theory. (IAA)

17509 CLASS RESTRICTIONS AND MASSIVE SCALAR FIELDS. Roy, A. R.; Rao, J. R. (Indian Inst. of Tech., Kharagpur). Gen. Relativity Gravitation; 4: No. 5, 357-360(1973).

It was established that no gravitational interaction is possible with a massive scalar field for a special "class one" metric. (auth)

17510 ELEMENTARY MECHANICS FOR ULTRAFAST TACHYONS. Haemaelaeinen, R. M. K. (Joensuu Univ., Finland). Joensuun Korkeakoulun Julkaisuja, Sar. B; No. 2, 109(1972).

The relativistic mechanics of faster than light particles is outlined. Some equations and formulas of elementary mechanics of particles with the velocity of $|u/c| \gg 1$ called ultrafast tachyons are given. Mechanics of ultrafast region can be studied according to these equations more easily than by using relativistic formulation. This is demonstrated by two examples. (auth)

17511 MEASUREMENT OF THE FREQUENCY OF LIGHT IN THE VISIBLE PART OF THE SPECTRUM AND A REDETERMINATION OF THE SPEED OF LIGHT IN VACUUM. Luther, G. G. Washington, DC; American Univ. (1973). 113p. University Microfilms Order No. 73-28,763.

Thesis (Ph. D.).

A relation was established between the frequency of the light emitted by a Lamb-dip stabilized laser and the international frequency standard. This relation was established by modulating the laser light at a known x-band frequency (about 10 GHz) and measuring in a high finesse Fabry-Perot interferometer the ratio of the wave lengths (and hence the frequencies) of the sidebands produced by the modulation. The frequency of the laser light thus determined in terms of the standard "second" is 473 612 169 ± 24 MHz. This is the first determination of a frequency in the visible part of the spectrum which does not make reference to the speed of light. The wave length of the Lamb-dip stabilized laser was measured with reference to the ^{86}Kr wavelength standard. The wave length of the laser was found to be 632.991472 nm. The product of the frequency ν and the wavelength λ of the laser yields a new value for the speed of light: c = 299 792 464 ± 15 M/second. (Diss. Abstr. Int., B)

17512 ELECTROMAGNETIC TEST FIELDS AROUND A SCHWARZSCHILD SINGULARITY. Stephani, H.; Herlt, E. (Friedrich-Schiller Univ., Jena, Ger.). Int. J. Theor. Phys.; 8: No. 4, 243-246(1973).

If the two invariants of an arbitrary nonstatic electromagnetic vacuum field are finite at the Schwarzschild radius r = M, the field behaves at r = M, either as a purely ingoing or as a purely outgoing wave. (auth)

17513 QUANTUM HAMILTONIAN FOR A CHARGE IN AN ELECTROMAGNETIC FIELD, IN GENERALIZED COORDINATES. Gruber, G. R. (Hofstra Coll., Hempstead, NY). Int. J. Theor. Phys.; 8: No. 4, 299-300(1973).

When one considers the quantum Hamiltonian for a charge in an electromagnetic field in Cartesian coordinates, no problem arises concerning the ordering of the quantum operators. However, if one considers the quantum Hamiltonian operator for a charge in an electromagnetic field in generalized coordinates, the question on the ordering problem becomes very apparent. Such a Hamiltonian operator is given. (UK)

17514 RENORMALIZED POWER OF A GENERALIZED RANDOM FIELD AND EQUATIONS FOR GREEN FUNCTIONS IN THE EUCLIDEAN DOMAIN. Gonchar, N. S. (Inst. of Theoretical Physics, Moscow). Teor. Mat. Fiz.; 17: No. 3, 373-390(Dec 1973). (In Russian).

The solvability of Schwinger equations for Green functions in the Euclidean domain for some types of self-interactions of one scalar field is investigated. The solvability of such equations is proven, and the integral representations for solution is found. (auth)

17515 GENERALIZED PAULI–VILLARS REGULARIZATION. Slavnov, D. A. (Moscow State Univ.). Teor. Mat. Fiz.; 17: No. 3, 342-358(Dec 1973). (In Russian).

A regularizing process which generalizes the Pauli–Villars regularization is worked out. The usual and chronological contractions of free field operators are represented as the weak limit of smooth functions. Due to the specially selected limit process, it proved possible to define without subtraction the multiplications of both usual and chronological contractions as distributions. (auth)

17516 TACHYON DUST. Ray, J. R.; Foster, J. C. Jr. (Clemson Univ., SC). Gen. Relativity Gravitation; 4: No. 5, 371-374(1973).

From international conference on gravitation and relativity; Copenhagen, Denmark (Jul 1971).

Tachyons, a class of particles which travel with speeds greater than the speed of light in vacuum, have space-like four velocities. Solutions to Einstein field equations are considered with a dust energy-momentum tensor which possesses a four-parameter isometry group acting on three-dimensional surfaces of transitivity. This metric has solutions only for space-like four-velocity of the dust. These are interpreted as solutions for a tachyon dust. (UK)

17517 SCALE DIMENSION OF CONFORMALLY COVARIANT SPINOR FIELDS. Drew, M. S. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 51: No. 12, 1278-1280(15 Jun 1973).

The spinor equation of Barut and Haugen is shown to admit no

solutions having a definite scale dimension in Minkowski space. (auth)

17518 PROPAGATOR PRODUCTS IN ARBITRARY DIMENSIONS. Akyeampong, D. A.; Delbourgo, R. (Imperial Coll. of Science and Tech., London). Nuovo Cim., A; 19: No. 1, 141-152 (1 Jan 1974).

The properties of propagator products in x-space in space-time of arbitrary dimension 2l are studied, viewing these products as generalized functions. In this way such questions are investigated as gauge invariance, singularities, commutation relations between field operators in perturbation theory, etc. By proceeding carefully to the limit of integer dimensions it is shown that there are no inconsistencies in the canonical equal-time commutators of fields and that the c-number current-current Schwinger term reduces to $\partial_x(\partial^2)^{l-1}\delta^{2l-1}(x)$ rather than the divergent distribution $A^{2l-2}\partial_x\delta^{2l-1}(x)$. Dimensional regularization is also applied to nonpolynomial interaction Lagrangians: there the close similarity with Mitter's analytic regularization demonstrates that the exponential superpropagator is characterized by a minimal singularity in four dimensions. (auth)

17519 FIELD PRODUCT RENORMALIZATION AND WILSON-ZIMMERMANN EXPANSION IN A CLASS OF MODEL FIELD THEORIES. Hegerfeldt, G. C. (CERN, Geneva); Klauder, J. R. Nuovo Cim., A; 19: No. 1, 153-172(1 Jan 1974).

A renormalization method is proposed for field operator products at the same points by a limiting procedure, a rigorous investigation of it in a class of field-theoretical models is presented, and its connection with the Wilson-Zimmermann expansion is discussed. Within the models existence and self-adjointness of the renormalized fields are proved, expressions for their matrix elements are determined, cyclicity of the vacuum with respect to any odd renormalized-field power is shown, and the renormalization is carried over to define functions of the field. Then a Wilson-Zimmerman-type expansion for field products at short distances is established. It is shown that the field associated with the leading singularity coincides with the renormalized-field power of the limiting process. The limit approach, however, has the advantage that one can check all required properties of this field. To do this directly from the expansion would be difficult. (auth)

17520 ULTRAVIOLET BEHAVIOR OF SPONTANEOUSLY BROKEN GAUGE THEORIES. Belokurov, V. V. (Moscow State Univ.); Kazakov, D. I.; Shirkov, D. V.; Slavnov, A. A.; Vladimirov, A. A. Phys. Lett., 47B: No. 4, 359-360(26 Nov 1973).

The asymptotic invariant coupling constant (ICC) in the repulsive σ^4 interaction is shown to be finite in the second logarithmic approximation. It leads to spontaneously broken gauge theories free of ultraviolet (UV) troubles. (auth)

17521 COMPATIBILITY OF SPINOR FIELD EQUATIONS WITH REGARD TO GENERALISATIONS TO WEYL'S LEMMA. Treder, H. J.; Borzeskowski, H. H. V. (Zentralinstitut fuer Astrophysik, Berlin). Int. J. Theor. Phys.; 8: No. 3, 219-225 (1973).

Generalizations of Weyl's lemma are discussed. In order to secure the compatibility of the spinor field equations, the generalizations may not be arbitrary. It is shown that a contracted Weyl lemma must be valid. This lemma "saves" the duality between the Lorentz covariant and the Einstein covariant representation of the equation of continuity. The meaning of Weyl's lemma and its generalizations is discussed in terms of the fibre bundle theory. (auth)

17522 FEW-BODY PROBLEM IN NONRELATIVISTIC QUANTUM FIELD THEORY. Capri, A. Z. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 17, 1861-1868(1 Sep 1973).

The fact that the nonrelativistic second-quantized formalism is simply a compact way of stating the n-body problem for arbitrary n, is used to derive the Schrödinger equations for few-body problems. This is particularly useful for models resulting from field theories in which a field is coupled to itself via another field, as in the case of nucleon-nucleon coupling via mesons. In this latter case, one obtains an effective nonlocal, energy dependent potential which itself depends on the possible states of the system. (auth)

17523 POSSIBILITY OF EXISTENCE OF A FINITE CHARGE IN THE QUANTUM FIELD THEORY. Avdeeva, G. M.; Belavin, A. A.; Protogenov, A. P. (Gorky State Univ., USSR). Yadern. Fiz.; 18: No. 6, 1309-1317(Dec 1973). (In Russian).

It is studied whether it is possible in the scalar meson theory to obtain anomalous dimensions close to the free ones. The expressions for invariant charges up to the terms $\lambda^n \ln^{n-1}(\Lambda^2/p^2)$ are found as well as the corresponding Gell-Mann-Low functions in these approximations. The character of singularities in fixed points of the renormalization-group differential equations (zeros of Gell-Mann-Low functions) is considered. The calculation results confirm the assumption on small deviations of anomalous dimensions from the free ones and therefore give evidence for possibility to obtain Bjorken's scaling in the field theory. (auth)

17524 HARMONIC OSCILLATOR IN STOCHASTIC ELECTRODYNAMICS. Santos, E. (Univ. of Valladolid, Spain). Nuovo Cim.; 19B: No. 1, 57-89(11 Jan 1974).

Classical electrodynamics with the hypothesis of a universal, Lorentz invariant, background radiation (stochastic electrodynamics) was proposed as a possible alternative to quantum electrodynamics. The stochastic equations of motion of a charged particle are derived according to this theory, and they are compared with those of Brownian motion. A development of the equations in powers of the fine-structure constant α is considered. The harmonic oscillator is studied with the result that the oscillator performs a simple harmonic motion very stable in phase. The amplitude changes slowly and at random. The mean values of the kinetic and potential energy are calculated and agree quite well with the results of quantum electrodynamics up to first order in α. The existence of excited states is shown which prove to be very similar to the coherent states of the quantum oscillator. The calculated rate of spontaneous emission of radiation agrees with the result of quantum electrodynamics but the line width does not agree. Arguments are given which show that the quantum line width calculated according to the Weisskopf-Wigner theory cannot be correct in the case of the oscillator. A general expression for the evolution of the expectation value of any observable of the oscillator in quantum electrodynamics is also derived. (auth)

17525 CLASSICAL PICTURE OF QUANTUM MECHANICS. Rosen, N. (Technion-Israel Inst. of Tech., Haifa). Nuovo Cim.; 19B: No. 1, 90-98(11 Jan 1974).

A classical picture of quantum mechanics is proposed, according to which the Schroedinger equation for a single particle describes an ensemble of identical particles together with a "quantum-mechanical" field. Each particle moves classically under the influence of the given external force plus a force due to the interaction with the field. The field is determined by the spatial distribution of the particles in the ensemble and has energy, momentum and angular momentum, in addition to those of the particles. (auth)

Gravitation and General Relativity

Refer also to abstracts 16694, 16945, 16948, and 17506.

17526 (NP-19915) TIME, GRAVITATION, AND THE UNIVERSE: THE EVOLUTION OF RELATIVISTIC THEORIES. Whitrow, G. J. (Imperial Coll. of Science and Technology, London (UK)). 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

An account is given of the historical development of the theory of relativity, particularly from Newton's mechanics and Maxwell's electrodynamics, and with reference to the importance of the work of 19th century mathematicians such as Riemann, Klein and Neumann, leading to the work of Poincaré, Minkowski, Lorentz and Einstein. The Michelson-Morley, Kennedy-Thorndike and Ives-Stillwell experiments are discussed, the use of the radar concept in relativity, and the discovery in 1965 of the universal black-body microwave radiation. Gravitation and cosmological problems are considered in historical review. (UK)

17527 (ORO-3992-156) IMPLICATIONS OF THE SHADOW EFFECT IN THEORIES OF GRAVITATION. Chiang, C. C.; Dykla, J. J.; Hwang, A. E. (Texas Univ., Austin (USA). Center For Particle Theory). 1973. Contract AT(40-1)-3992. 14p. (CPT-200). Dep. NTIS $3.00.

Following the idea of the theory of shadow states in quantum field theory, a Newtonian theory and a Whitehead's theory of gravitation are constructed with shadow, gravitational potentials. As a heuristic approach, Einstein's theory of gravitation is modified by introducing the shadow effect. This is achieved by using the effective mass distribution which arises in the Newtonian theory of gravitation with shadow effect as the only non-vanishing component of the stress-energy momentum tensor of a static point source. It is found that in the static spherically symmetric solution of Einstein's equations, with proper choice of the new dynamical parameter, there is no surface of infinite red shift and the formation of a black hole can be avoided, leaving a naked singularity at the origin. (auth)

17528 PHYSICS OF THE SCIENTIST: MECHANICS, RELATIVITY, GRAVITATION. Faulk, G.; Ruppel, W. Berlin; Springer-Verlag (1973). 455p. (In German). $12.10.

Aspects related to the concepts of momentum and energy are examined, giving attention to the transport of energy and momentum, the concept of the particle, and the measurement of momentum and energy. Collision processes are discussed together with the characteristics of fields and the angular momentum. Subjects considered in connection with the theory of relativity include reference systems and geometry, Newton's absolute space and time, inertial systems and the principle of relativity, noninertial reference systems, the relativity of time, gravitational fields producing a curvature of the space-time universe, and the connection between curvature and the distribution of energy and momentum in the universe. Newton's gravitational theory is discussed together with Einstein's theory of gravitation, gravitational waves, and cosmological questions. (IAA)

17529 GRAVITATION FOR PEDESTRIANS. Schmidle, H. (Technische Hochschule, Aachen). Acta Univ. Wratislaviensis; 2: No. 164, 182-201(1972).

An introduction is given into the field theoretic approach to gravitation as opposed to Einstein's approach. It is shown that the field theoretic approach has not only the advantage of having started with field theoretic methods but it gives also an interesting insight into the structure of general relativity. (JFP)

17530 METHOD FOR NUMERICAL INTEGRATION OF TIME-DEPENDENT EINSTEIN EQUATIONS. Pachner, J. (Univ. of Saskatchewan, Regina); Teshima, R. Can. J. Phys.; 51: No. 7, 743-750(1 Apr 1973).

A method for the numerical computation of the initial data and for the numerical integration of the exact Einstein field equations is described for the case of a rotating incoherent matter with axial symmetry. The results of the integration show that the method gives reliable results. (auth)

17531 LIKELIHOOD OF GRAVITATIONAL WAVES. Fellgett, P. B. (Univ. of Reading, Eng.). J. Phys., E (London); 6: No. 12, 1239-1240(Dec 1973).

Most discussions of gravitational wave detectors has hitherto been directed to optimization of the signal-to-noise ratio, leaving as a separate matter the question of interpretation of the observed waveforms and particularly of putative "events" observed simultaneously or with delay in individual detection systems. Maximization of signal-to-noise ratio is in fact only a means to the end of optimizing the modification of the probabilities assigned to hypotheses about gravitational radiation as a result of making the observations. A likelihood analysis is presented which appears able to tackle this problem directly in a way which automatically specifies optimal filtering and data-processing requirements. (UK)

17532 ROTATING INCOHERENT MATTER IN GENERAL RELATIVITY. Pachner, J. (Univ. of Saskatchewan, Regina). Can. J. Phys.; 51: No. 4, 477-490(15 Feb 1973).

Under the assumption of rotational symmetry a method is developed for the numerical integration of exact Einstein equations describing the time evolution of a rotating incoherent matter. The complete system of equations deduced earlier for the case of an ideal fluid reduces here to six Einstein field equations and to the equation of continuity. The choice of the system of comoving cylindrical coordinates (z, r, ϕ, t) is restricted by further conditions so that the only allowed coordinate transformations are the translations of the origin of the coordinates z, ϕ, and t, and the reflections in these three axes. Any set of the permissible initial values of the field corresponds then to only one physical situation. The exact field equations are deduced. With the exception of a few terms they are invariant with respect to certain permutations. The requirements upon the field to be regular at the initial moment and its infinitesimal past and future imposes restrictions on the functions appearing in the components of the metric field. Even then the field equations contain terms that have an indeterminate form 0/0, but are finite, at the z axis. Therefore two sets of field equations must be used: one set for the z axis in which the indeterminacy is analytically evaluated, and the other set for the space with $r > 0$. The junction conditions for the external field are formulated and proved that the corresponding external field does exist. The problem of the Lichnerowicz initial conditions is solved. An analytical proof is given that the rotation can stop the contraction of incoherent matter and revert it to a new expansion even along the axis of rotation. In terrestrial physics the axial acceleration is negligibly small, but it may play an essential role in cosmology. (auth)

17533 MASS OF THE GRAVITON. Hare, M. G. (Univ. of Saskatchewan, Regina). Can. J. Phys.; 51: No. 4, 431-433(15 Feb 1973).

The graviton is assumed to have a mass, and it is allowed to decay into two photons. From the transition probability for this decay an illustrative restriction is placed upon the graviton mass. Restrictions are also made on the mass with regards to the speed of propagation of gravitational radiation and to the range of gravitational forces. (auth)

17534 NEUTRINO RADIATION IN SPHERICALLY-SYMMETRIC GRAVITATIONAL FIELDS. I. The Energy-Momentum Tensor for the One-Neutrino and Many-Particle Neutrino Field. Griffiths, J. B. (Loughborough Univ. of Tech., Eng.). Gen. Relativity Gravitation; 4: No. 5, 361-370(1973).

The physical situation of a star emitting neutrinos is considered. Some difficulties in the classical theory are mentioned, and a more detailed approach to the properties of neutrino radiation in general relativity is given. The classical theory is regarded as a one-particle theory, and by summing over many particles propagating in random radial directions, the energy-momentum tensor of the total radiation field is shown to approximate to the "geometrical optics" type satisfying other conditions defining its radial and time dependence. (auth)

17535 ELECTROMAGNETIC FIELD IN THE GAUGE THEORY OF GRAVITATION. Chang, Y. C.; Kuo, H. Y. K'o Hsueh T'ung Pao; 18: No. 3, 122-123(Sep 1973). (In Chinese).

A discussion of the electromagnetic field in the gauge theory of gravitation. Specifically, it points out that under the assumption of U(1) gauge invariance of the electromagnetic field, the equations are of identical form as the general theory of relativity; and the dynamic spin flow of the electromagnetic field is zero; hence in the gravitational field, light still propagates along the zero geodesic. However, the interference of the gravitational field will produce such effects as light refraction and shift of the red spectral line. (JPRS)

17536 SOME VACUUM SOLUTIONS OF THE GAUGE THEORY OF GRAVITATION AND VERIFICATION BY THREE KNOWN EXPERIMENTS. K'o Hsueh T'ung Pao; 18: No. 3, 119-121(Sep 1973). (In Chinese).

Solutions of the Einstein–Young field equations based on the gauge theory of gravitation were obtained. Preliminary results indicate that: the interference-free solution of the field equation includes the vacuum solution of the general theory of relativity; under the conditions of spherical-symmetric static field and zero curvature at infinity, the solution is always interference-free and reduces to the Schwarzschild solution; in the case of parallel plane wave (pp wave), the field equations contain only the pp wave solution of the general theory of relativity. In addition, the calculated results are in complete agreement with the general theory and the three experimental results: Mercury advance, red-shift and light refraction. (auth) (JPRS)

17537 FLUID SPHERE OF UNIFORM DENSITY IN GENERAL RELATIVITY. Rao, J. K. (South Gujarat Univ., Surat, India). Gen. Relativity Gravitation; 4: No. 5, 351-355(1973).

It is shown that for spherically symmetric perfect fluid solutions, with spatial isotropy and uniform density, the free gravitational field produces a singularity at the center of the sphere and when this singularity is removed the space-time is conformally flat. It is pointed out that the interior geometry of the fluid spheres with uniform density given by Thompson and Whitrow (Mon. Notes Roy. Astron. Soc.; 136: 207(1967)), and others, is conformally flat, and hence the space-time is of class one. (auth)

17538 NEW MODEL OF GRAVITATIONAL INTERACTION. Novello, M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 6, 111-116(1973).

A new view of the gravitational interaction is proposed. This theory is speculative, but it is hoped it can give a new insight on gravitational theory that could throw a new light on the final state of collapsed matter. (JFP)

17539 FINITENESS OF RELATIVE ACCELERATION AT THE SURFACE $r = 2m$. Prasanna, A. R. (International Centre for Theoretical Physics, Trieste, Italy). Int. J. Theor. Phys.; 8: No. 4, 237-242(1973).

It is shown that the relative acceleration between neighboring particles in the field of an isolated mass is finite at the apparent singular surface $r = 2m$. The analysis is made both in Schwarzschild and Eddington-Finkelstein coordinate systems by using the equation of geodesic deviation. (auth)

17540 NEW APPROACH TO GENERAL RELATIVITY. Hojman, S. A.; Kuchar, K.; Teitelboim, C. (Princeton Univ., NJ). Nature (London); 245: No. 146, 97-98(15 Oct 1973).

It is pointed out that if one did not know the Einstein–Hamilton–Jacobi equation one might hope to derive it straight off from plausible first principles, without ever going through the formulation of the Einstein field equations themselves. (auth)

17541 TIME-LIKE CLOSED SMOOTH CURVES IN GENERAL RELATIVITY. Guts, A. K. (Novosibirsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 33-36(1973). (In Russian).

For the space-time postulating time-similar closed smooth curves, an evaluation was obtained for $\tau \sim 2 \times 10^{-24} \sqrt{\rho}\, l^2$ where τ is the actual time and l is the spatial length associated with the time-space curve; ρ is the density of matter. (tr-auth)

17542 GRAVITATION ANALOG OF THE ZEEMAN EFFECT. Guts, A. K. (Novosibirsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 30-33(1973). (In Russian).

Formulas were obtained making it possible to calculate the spin-gravitation interaction, analogous to the Zeeman effect. (tr-auth)

17543 OBSERVABLES OF THE SCHWARZSCHILD FIELD. Dozmorov, I. M. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 103-107 (1973). (In Russian).

The question on the determination of observables in the gravitational field, i.e., magnitudes which can be measured by real observers, was analyzed. The concept of fundamental observables, obtainable by the projection of tensors in the frame of reference of the observer falling in the gravitational field, was introduced. The meaning of the concept introduced is explained on the example of the investigation of the gravitational field of a spherical static source. (tr-auth)

17544 DYNAMICS OF THE GRAVITATIONAL FIELD. IV. Dozmorov, I. M. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 99-103(1973). (In Russian).

The basis for the assumptions made during the construction of the dynamic theory of gravitational fields was derived. For this purpose the results of recent investigations of different authors, devoted to the establishment of correspondence between the dynamic field theory in plane space and the general relativity theory, were cited. (tr-auth)

17545 RADIATION EMITTED BY AN ULTRARELATIVISTIC PARTICLE IN A GRAVITATIONAL FIELD. Khriplovich, I. B.; Shuryak, E. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2137-2140(Dec 1973). (In Russian).

The electromagnetic and gravitational radiation emitted by an ultrarelativistic particle in an external gravitational field is considered. The intensities of the radiation and their angular and spectral distributions are estimated for the cases of circular and infinite trajectories in a Schwarzschild field. (auth)

17546 ALGEBRAICALLY SPECIAL METRICS. Damiao Soares, I. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 16, 337-351(1973).

Classes of algebraically special Einstein's geometries are examined, associated to a congruence of null geodesics, hypersurface orthogonal. Writing field equations in a null frame[2] adapted to the congruence, the role of null rotations of the frame in generating new solutions (or in eliminating them) is made explicit. A simple case is treated as an example. (auth)

REACTOR TECHNOLOGY AND REGULATION

17547 (CONF-731039-1) EXPERIENCE ACQUIRED IN THE DESIGN AND CONSTRUCTION OF OPERATING PLANTS. Leine, L. (ASEA-ATOM AB, Vaesteraas (Sweden)). [nd]. 9p. Dep. NTIS (U.S. Sales Only) $3.00.

From 5th Foratom Congress on nuclear power plants in Europe; Florence, Italy (15 Oct 1973).

Some of the problems encountered during the design and construction phase of nuclear power plants in Sweden are described. The importance of timing and the main causes of schedule delays are discussed. (JWR)

17548 (IAEA-147, pp 1-16) RESEARCH AND DEVELOPMENT IN THE INDIAN NUCLEAR ENERGY POWER PROGRAM. Ramanna, R. (Bhabha Atomic Research Centre, Trombay, India). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The status of the entire Indian nuclear research and development program is outlined. The present status and the 10 year profile of the nuclear power program is described. Existing and planned facilities, research and development activities and manpower requirements are discussed. Research reactors at Trombay, nuclear power reactors in India, and the characteristics of a variable energy cyclotron (under construction), a pulsed fast reactor (under design) and a fast breeder test reactor are listed. (auth)

17549 (TID-3339-P3-1) GAS-COOLED REACTOR TECHNOLOGY. A Bibliography (Part 3). Norris, J. W. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 716p. Dep. NTIS $13.60.

Citations to 4372 abstracts containing information on gas cooled reactors found in NSA Volumes 21 through 27 are presented. The citations contain volume and abstract number, title, author, corporate author, report number or journal source, and other information. The NSA subject indexing for each item is included. (JWR)

17550 (TID-3339-P3-2) GAS-COOLED REACTOR TECHNOLOGY. A Bibliography (Part 3). Norris, J. W. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 330p. Dep. NTIS $10.60.

The NSA indexing for all citations found in Part 3 is presented. Included are corporate author, personal author, subject, and report number-availability indexes. (JWR)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 15507, 15509, 15526, 16408, 17669, 17673, 17689, 17694, 17715, 17739, 17748, 17754–17756, 17762–17786, 17793–17808, 17825, 17827–17831, 17847–17853, 17867, 17868, 17875, 17877–17880, 17884, 17888, 17889, 17891, 17892, 17894, 17896, 17900–17904, and 17908.

17551 (AECL-4429) PROCEEDINGS OF THE SYMPOSIUM ON CORROSION CONTROL BY DESIGN IN CANDU NUCLEAR POWER REACTORS HELD AT POWER PROJECTS ON OCTOBER 18, 1972. Atkinson, J. T. N.; LeSurf, J. E. (eds.). (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1973. 73p. (CONF-7210111-). Dep. NTIS (U.S. Sales Only) $5.75. AECL $2.00.

Information is presented concerning problems of corrosion in BWR type reactors and PHWR type reactors. Corrosion of equipment associated with the steam generators, cooling system, and fuel assemblies is described. Different reactor materials are compared for corrosion resistant characteristics. (DCC)

17552 (IAEA-145, pp 123-154) PERIODIC INSPECTION OF OSKARSHAMNSVERKET REACTOR VESSEL. Ahlberg, G. (Aktiebolaget Atomenergi, Stockholm); Lautzenheiser, C.; Sandberg, O. 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The Oskarshamnsverket is a boiling-water system operating at 70 bars pressure and with an output of 440 MW(e). The system was designed and constructed by ASEA of Sweden on a turn-key basis. Early in the design phases, efforts to formulate a periodic inspection program were initiated. This program was based on the design analysis and utilized ultrasonic information generated during fabrication of the vessel. Problems of access for inspection became apparent and ASEA made changes to allow inspection of selected points. Equipment was designed to perform an ultrasonic inspection of the vessel shell including the welds, the steam outlet nozzles, the recirculation nozzles, and the studs. Equipment was also designed to maneuver the ultrasonic apparatus and a remote television camera within the vessel. All of the equipment was designed for precise positioning and repeatability so as to accurately reproduce the initial inspection during future inspections. The overall inspection program and equipment included a Data Acquisition System to accumulate information relating inspection position with ultrasonic indications. A simulated inspection of the reactor is to be made using the equipment to determine access and operation problems. The final data generated will be a "fingerprint" inspection of the reactor pressure vessel for use as a reference basis for future inspections. (auth)

17553 (INIS-mf-923) PRELIMINARY STUDY ON THE ADVANTAGES OF A FUEL ROD WITH TRANSVERSAL SECTION SIMILAR TO A ERYTHROCYTE. Chien, C. T. (Sao Paulo Univ. (Brazil). Escola Politecnica). 1971. 76p. (In Portuguese). INIS.

Circular crossed area fuel elements for BWR and PWR reactors with a crossed area shape similar to the erythrocytes are investigated. Considering the thermal aspects of the problem it was possible to increase the specific power value in about 23% in relation to the conventional cylindrical shape. The fabrication costs of these new shaped fuel elements are low, meaning that the energy cost from nuclear power plants can be greatly reduced (about 10%, at least, in the cost of a 500 MW(e), BWR power plant). (INIS)

17554 SPACERS FOR FUEL PINS IN LIGHT WATER REACTORS. Froemel, G. (to Siemens AG). German Patent 2,161,229. 20 Jun 1973. 9p. (In German).

The spacer grid described consists of two grid elements arranged parallel to each other, which are connected to one another by spacer sleeves. The sleeves consist of a neutron transparent material and are joined to the elements by special spot welding. The grid elements are surrounded by a bandage blanket. (GE)

17555 SAFETY DEVICE FOR PRESSURE VESSELS, PARTICULARLY OF THE TYPE ASSOCIATED WITH NUCLEAR REACTORS. Schabert, H. P. (to Siemens Aktiengesellschaft). US Patent 3,775,251. 27 Nov 1973. Priority date 8 Sep 1970, F. R. Germany. 6p.

As a safety measure relating to pressure vessels of nuclear reactors, there is provided a safety tank surrounding the pressure vessel at least in its upper range and a guard ring overlapping the upper edge of the safety tank. The guard ring is disconnectably secured by means of bolts extending within the safety tank to a carrier ring situated under the nipples of the pressure vessel. (Official Gazette)

17556 HEAT FLOW DIAGRAMS FOR VARIOUS TYPES OF POWER PLANTS. Hoffmann, J. (Kraftwerk Union AG, Erlangen, Ger.). Tech. Mitt.; 66: No. 10/11, 460-467(1973). (In German).

The heat flow diagrams for a conventional power plant in a unit arrangement, for a nuclear power plant with a pressurized water reactor, as well as for a nuclear power plant with a boiling water reactor are explained, and their special points are discussed. The possibilities of improving the specific heat consumption of the turbine by regenerative pre-heating were investigated, as well as the partial load behavior. Furthermore, a heat flow diagram of an industrial power plant, complete heat flow diagram for a 600 MW power station unit, and for 1,300 MW nuclear power plant are described. (GE)

17557 NUCLEAR POWER PLANT WITH BOILING WATER REACTOR. Schill, J. (to Sulzer Bros. Ltd.). German Patent 1,962,312. 5 Apr 1973. 3p. (In German).

A system for cooling medium circulating pumps and high pressure coolant injection pumps is described. The circulating pumps are operated by a series of connected water turbines whose capacity is influenced by a series of regulating apparatuses. The arrangement of pumps and regulating parts are described. (GE)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 15507, 15509, 15526, 15670, 16408, 17553–17556, 17667, 17669, 17672, 17681, 17686, 17694, 17715, 17744–17747, 17750–17753, 17758–17761, 17787–17792, 17809–17815, 17819–17824, 17826, 17832–17846, 17854–17866, 17869–17874, 17876, 17885, 17888, 17889, 17891, 17892, 17894, 17896, 17900–17904, and 17908.

17558 (IAEA-145, pp 357-382) TRINO NUCLEAR POWER STATION: IN-SERVICE MONITORING OF REACTOR INTERNALS. Calcagno, M. (ENEL, Rome); Cioli, F.; Gadola, A.; Possa, G.; Vanoli, G. 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The on-line surveillance program, which was set up with the aim of after repair monitoring of the structural integrity of the Trino reactor internals, is presented. Since the installation of sensors on irradiated structures inside the reactor vessel was found to be unpractical, the surveillance was based on techniques that use sensors placed outside the vessel. These techniques utilize neutron noise, accelerometer signals, and main coolant pressure noise. (auth)

17559 (WARD-TM-1070) HOTROD: A COMPUTER PROGRAM FOR SUBCHANNEL ANALYSIS OF COOLANT FLOW IN ROD BUNDLES. Beus, S. G.; Anderson, J. H.; DeCristofaro, R. J. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Nov 1973. Contract AT(36-1)-GEN-14. 125p. Dep. NTIS $8.25.

A digital computer program is described for the steady-state thermal and hydraulic subchannel analysis of coolant flow in rod bundle reactor cores and heated-rod experimental test sections. The program allows for the transfer of two-phase fluid properties in three dimensions and predicts the local fluid conditions, fuel rod surface temperature and critical heat flux. The history of subchannel analysis in rod bundles is discussed. A detailed description is presented of the HOTROD analytical model, the numerical solution procedures and the program input formats. (29 references) (auth)

17560 REVIEW CONTRIBUTION ON THE PHOSPHATE REGIME IN NUCLEAR STEAM GENERATORS. Samuel, T. (Nordostschweizerische Kraftwerke AG, Doettingen, Ger.). VGB Kraftwerkstechnik; 53: No. 10, 672-674(1973). (In German).

Damage which has occurred recently to the pipework of nuclear steam generators with vertical U pipe-assemblies has been attributed principally to the chemical conditions of the water of the steam generators. Reactor suppliers have therefore revised and tightened recommendations concerning steam generator water. The basis for current recommendations is critically examined. (GE)

17561 STEAM GENERATOR FOR PRESSURIZED WATER NUCLEAR REACTORS. Michel, E. (to Siemens Aktiegesellschaft). US Patent 3,783,838. 8 Jan 1974. Priority Date 11 Jun 1971, F. R. Germany. 4p.

A steam generator for pressurized water nuclear reactors has an upright U-tube bundle of heating surface members. A cylindrical hollow chamber is provided at the center of the U-tube bundle and serves as preseparator for a steam-water mixture supplied tangentially to the chamber from a region of the U-tube bundle which contains the vertically extending legs, whereby water is separated from the steam-water mixture and flows downwardly while steam containing remnant moisture entrained therein flows upwardly from the hollow chamber. A fine separator is diposed between a portion of the U-tube bundle and the hollow chamber and separates the remnant moisture from the upwardly flowing steam to produce purified steam. The steam then passes through the above-mentioned portion of the U-tube bundle with the remnant moisture removed thereby providing increased superheating of the steam. (Official Gazette)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 15433, 15517, 16119, 16124–16126, 16131, 16165, 16368, 17757, 17816–17818, and 17908.

17562 (IAEA-151, pp 331-348) IMPLEMENTATION OF CERTAIN NUCLEAR POWER PLANT PROJECTS IN THE UNITED KINGDOM. Joss, J. O. (Nuclear Power Group, Knutsford, Eng.). 1972.

A report is given on the implementation of nuclear power plant projects in the United Kingdom. In the UK there are two companies concerned with design and construction of reactors, nuclear islands or complete turn-key projects. These are two of the old consortia, reconstituted as private limited liability companies. The previous members of the consortia are now the shareholders of the new companies. The experience of TNPG Ltd. and its precursor consortia NPPC and AEI-John Thompson are discussed. Some problems concerning: the reactor type, project experience – the early Magnox plants (1) Bradwell, the early Magnox plants (2) Latina (Italy), the later Magnox plants and the AGR plants are discussed. (INIS)

17563 (ORNL-4926) ANALYSIS OF CHEMICAL FAILURE OF COATED UO_2 AND OTHER OXIDE FUELS IN THE HIGH-TEMPERATURE GAS-COOLED REACTOR. Lindemer, T. B.; de Nordwall, H. J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 85p. Dep. NTIS $5.45.

The thermodynamic data for unirradiated dioxides in the U–Th–Pu–O system are briefly reviewed. Calculations of oxygen release during fission were made and were found to agree qualitatively with experimental measurements. Theories were developed for prediction of mass transport rates in oxide particles; these included control by either CO–CO_2 diffusion, reactions such as disproportionation of carbon monoxide, or solid-state diffusion through the kernel. Methods were devised for the determination of the general type of rate-controlling mechanism from the quantitative analysis of in-reactor and out-of-reactor experiments. Application of these methods to an in-pile experiment indicated that CO–CO_2 diffusion did not control the rate of UO_2 or $(Th,U)O_2$ migration in BISO particles; instead, control by solid-state diffusion was indicated. (54 references) (auth)

17564 (RD/B/N-2773) CALIBRATION OF ORIFICE PLATES USED IN AGR SINGLE PIN TESTS IN NO. 2 CO_2 RIG AT BERKELEY NUCLEAR LABORATORIES. Pirie, M. A. M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Calibration was made of a 1 in. orifice plate for mass flow rate measurement which is incorporated in a test channel used for single pin heat transfer and pressure drop tests. At the same time a 1.5 in. CO_2 rig orifice plate was calibrated. The range of flow rates was that used for single pin testing. Expressions are given that allow direct computation of the true mass flow rate from the usual orifice plate data. The discharge coefficient determined from this calibration is subject to an error with 95% confidence interval of ±0.5%. (auth)

17565 METHOD TO DETERMINE THE NEUTRON ABSORPTION AND MULTIPLICATION PARAMETERS FOR CLUSTER-TYPE NUCLEAR FUEL ELEMENTS. Corno, S. E. (to Snam Progetti S.p.A. L.R.S.R.-Brevetti). US Patent 3,776,813. Dec 1973. Priority date 4 Jul 1968, Italy. 10p.

The neutron absorption and multiplication parameters are determined for heavy water (D_2O) or graphite moderated heterogeneous power reactors by irradiating a single fuel element cluster positioned along the longitudinal axis of a given column of moderator and taking neutron flux measurements at suitable radial and axial positions. The critical dimensions and power distribution for a heterogeneous core made up of a plurality of fuel element clusters of the type irradiated are derived from the neutron flux measurements by means of the so-called "source-sink" heterogeneous reactor theory. (Official Gazette)

17566 GAS COOLED NUCLEAR REACTORS. Rapier, A. C. (to United Kingdom Atomic Energy Authority). US Patent 3,781,190. 25 Dec 1973. Priority Date 22 Mar 1971, United Kingdom of Great Britain and Northern Ireland. 2p.

A nuclear reactor is described wherein stacks of fuel elements are supported centrally within vertical channels of a graphite moderator by annular discs disposed at each end of each fuel element. The discs have inner and outer diameters to correspond with inner and outer diameters of the fuel elements and conical seats complementary to tapers on the ends of the fuel elements. The lowermost disc is secured to the wall of the channel while the remainder are free to slide. The construction maintains uniform coolant flow passages through and about the fuel elements and allows for irradiation growth of the fuel elements and graphite moderator. (Official Gazette)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 15504, 17551, and 17565.

17567 (EBO-310-22) ACTIVITY OF MATERIALS IRRADIATED IN REACTOR KS-150. Rana, S. B.; Kupcova, A. (Atomova Elektraren, Jaslovske Bohunice (Czechoslovakia)). 1971. 53p. (In Slovak). INIS.

A summary is given of data on the determination of gamma dosage rate of fuel elements irradiated in the KS-150 reactor, and on the calculation of induced activity of materials irradiated in this reactor. A calculation of thermal neutron flux density per unit thermal output of reactor is made for various core configurations. (auth)

17568 (IAEA-145, pp 69-77) INSPECTION SYSTEM FOR USE PRIOR TO AND DURING SERVICE FOR THE PRESSURE VESSEL

IN THE ATUCHA REACTOR. Baez, J. N. (Comision Nacional de Energia Atomica, Buenos Aires). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The Atucha reactor, the first Nuclear Power Plant in Argentina, is scheduled to produce 319 MW(e) in 1973. The in-service inspection system for the vessel is described. The scanning device, the transducers, the inspection technique, and data acquisition system are outlined and general characteristics discussed. (auth)

17569 (IAEA-145, pp 493-499) INSPECTION OF SGHWR PRESSURE TUBES. Cockaday, R. E. 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The pre- and post-service inspections of the zirconium alloy pressure tubes installed in the Steam Generating Heavy Water Moderated Reactor (SGHWR) situated at Winfrith, Dorset UK, are described, and details of the pressure tube bore measuring gauge and internal viewing equipment used for periodic surveillance inspection are given. (auth)

17570 THERMAL NUCLEAR REACTOR. Hilborn, J. W.; Mathers, W. G.; Lennox, C. G. (to Atomic Energy of Canada Ltd.). German Patent 2,019,156. 26 Apr 1973. 5p. (In German).

A light-water-cooled heavy-water-moderated reactor is described in which, between the core liner and core blanket, a cylindrical ring channel is situated to take up the cooling medium. The core liner consists of graphite and is exceptional due to its high thermal isolation properties. Special construction measures serve the cooling water and the heavy water moderator. (GE)

Power Reactors, Breeding

Refer also to abstracts 17635 and 17749.

17571 (ANL-CT-73-23) METHOD OF CHARACTERISTICS FOR PRESSURE TRANSIENTS IN CYLINDRICAL GEOMETRY WITH AXIAL SYMMETRY: THE FORMULATION. Shin, Y. W. (Argonne National Lab., Ill. (USA)). Oct 1973. 31p. Dep. NTIS $3.75.

The system of governing equations for an unsteady inviscid compressible flow is formulated by the method of characteristics for numerical integration. An axially symmetric cylindrical geometry is considered which simulates a simplified geometry of steam generators. The resulting reduced equations, the bicharscteristic and compatibility equations involve one less independent variable than the original system of equations. The system of governing partial differential equations if reduced to a system of integral equations written along bicharacteristics. Numerical integration can be performed either using the compatibility relations by writing in finite differences or using the system of integral equations by various approximation techniques. (11 references) (auth)

17572 (ANL-CT-74-1) SINGLE CHANNEL SODIUM VOIDING EXPERIMENTS USING LMFBR PARAMETRIC CONDITIONS. France, D. M.; Carlson, R. D.; Rohde, R. R.; Charmoli, G. T. (Argonne National Lab., Ill. (USA)). Jan 1974. 29p. AT.

Sodium voiding during the initial time period subsequent to boiling inception was studied experimentally under forced convection with system parameters typical of liquid metal fast breeder reactors. The annular flow area of the test section simulated a single reactor fuel element of three ft. heated length. Transient void formations were measured along the test section length. Initial sodium voiding characteristics were related to the maximum bulk superheat existing in the test section at the time of boiling inception. Significant differences in test section voiding were obtained under conditions of zero and high (100-160°F) superheats. Loop and pot type reactor simulation conditions were employed. (13 references) (auth)

17573 (ANL-RDP-21) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, OCTOBER 1973. (Argonne National Lab., Ill. (USA)). 30 Nov 1973. Contract W-31-109-eng-38. 157p. AT.

Progress in LMFBR development studies is reported under the following headings: EBR-2; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; and reactor safety. (JWR)

17574 (EURFNR-1112) DESIGN, IRRADIATION, AND POST-IRRADIATION EXAMINATION OF THE UO_2/PuO_2 FUEL PIN IRRADIATION EXPERIMENTS OF FR-2 CAPSULE TEST GROUP 4a. Freund, D.; Dippel, T.; Geithoff, D.; Weimar, P. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Apr 1973. 237p. Dep. NTIS $14.00.

Work performed under United States-Euratom Fast Reactor Exchange Program.

The irradiation of 28 fuel pin samples with UO_2-PuO_2 fuel of the experiment called "Capsule Group No. 4a", irradiated in the thermal flux of the Karlsruhe research reactor FR 2, represents a first testing of the SNR basic fuel pin concept. The irradiation has been carried out in 9 Na/PbBi double-capsules, where 3-4 samples are stacked one above the other. The fuel column of 80 mm length consists of pellets with a Pu-content of 15 w/o. Two different fuel densities of 85 and 92% T.D., corresponding to smeared densities of 81 resp. 84% T.D., have been realized. The austenitic stainless steel claddings have an outer diameter of 7.4 mm with a wall thickness of 0.5 mm. The total length of the fuel pin is 172 mm. The capsules have been irradiated at normal fuel element or isotope canal positions. At linear rod powers up to 700 W/cm and clad surface temperatures of max. 600°C the burnup lies between 10 and 90 MWd/kg metal. The samples have been irradiated between 57 and 578 days full power (44 MW) equivalent. All fuel pins are intact in spite of single central fuel melting. A compilation of design, specification and fabrication as well as a detailed description of irradiation and post irradiation examination results are given. (15 references) (auth)

17575 (GEAP-13771-8) NUCLEAR DESIGN AND SHIELDING EIGHTH QUARTERLY REPORT, JULY-SEPTEMBER 1973. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Sep 1973. Contract AT(04-3)-893. 94p. AT.

Current activities and technical progress for the period July through September 1973, are reported for four subtasks. Subtask A covers the post-analysis of the Demonstration Plant Benchmark Critical Experiments in ZPPR-3 and the technical direction and analysis of similar experiments in ZPPR-4. Subtask B is in support of the nuclear data evaluation and testing efforts and methods development for the national LMFBR program. Subtask C is directed toward the development of calculational methods that can be used at the sites of the Demonstration and later LMFBR Plants to determine the reactor power distribution, reactivity and fuel status, and for consideration of alternate fuel and control management schemes. Subtask D progress is reported for the post-measurement analysis of axial shield and radial stainless steel versus B_4C neutron attenuation experiments. (auth)

17576 (IAEA-145, pp 443-454) AUTOMATIC CONTROL BY ULTRASONICS OF THE ANGLE WELD OF THE PHENIX VESSEL COVER. Monnier, P.; Roule, M.; Saglio, R. (DMECN/DTEC/SECS/STA, Saclay, France). 1972. (In French).

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

The ultrasonic device constructed to control the welds on the cover vessel of the Phenix is described in detail. The results obtained showed that the device operated as desired and the reproducibility of the results was perfect. (JSR)

17577 (ORNL-TM-4356) HIGH-TEMPERATURE STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS. Quarterly Progress Report for Period Ending June 30, 1973. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 192p. AT.

Research progress is discussed for the following areas: material behavior tests; constitutive equation development; failure studies; development, evaluation, and distribution of structural analysis methods and tools; inelastic structural tests; design criteria; and core structures design criteria and data. (JWR)

17578 (RT/ING-(73)-6) ANALYSIS OF FACTORS INFLUENCING THE SUPERHEAT ON THE BASIS OF THE EXPERIMENTAL DATA. Scarano, G.; Iannuzzo, P.; Pezzilli, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1972. 15p. (CONF-721154-1; RVI-PEC-718). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting on liquid metal boiling working group; Karlsruhe, F. R. Germany (6 Nov 1972).

An analysis of experimental results available in literature on forced convection liquid-metal superheat is presented in order to study the influence of the velocity on the superheat. The analysis was presented and discussed at the last CREST-OECD Liquid Metal Boiling Working Group meeting, Karlsruhe 6-7 November 1972. 6 references. (auth)

17579 (TID-3333-81) LIQUID METAL FAST BREEDER REACTORS, 1972-1973. (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 337p. Dep. NTIS $10.60.

References to 1467 publications on liquid sodium fast breeder reactors cited in Nuclear Science Abstracts Volume 26 (1972) through Volume 27 (1973 through June) are contained in this bibliography. The NSA subject indexing is displayed under each citation to provide information on the contents of the document. References are arranged in order by the original NSA abstract number which approximately places them in chronological order. Sequence numbers appear beside each reference, and the personal

author index refers to these sequence numbers. The subject index refers to the original abstract numbers. (auth)

17580 (WARD-HT-3045-3) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA. Quarterly Progress Report for Period Ending August 31, 1973. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1973. Contract AT(11-1)-3045. 63p. AT.

Research on the inelastic behavior and strain tolerances of Types 304 and 316 stainless steel base materials for LMFBR components is reported. Testing of plates, bars, tubular specimens, and more complex structures is described. The design of the Multiloading Test Facility is reviewed. Studies on creep ratcheting of the FFTF intermediate heat exchanger inlet nozzle are discussed. Improvements in the structural analysis codes used are summarized. (JWR)

17581 (WARD-OX-3045-4) OXIDE FUEL ELEMENT DEVELOPMENT. Quarterly Progress Report for Period Ending September 30, 1973. Boltax, A.; Saling, J. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). Jan 1974. Contract AT(11-1)-3045. 96p. AT.

Progress in the development and testing of stainless steel clad mixed oxide fuel pins for LMFBRs is reported. Irradiation tests in EBR-2 are described. Work on the mechanical, thermal, and hydraulic design of grid-type assemblies for the FFTF is reviewed. Studies of radiation effects on Type 304 and Type 316 stainless steels are discussed. (JWR)

17582 HEAT EXCHANGER. Fiebelmann, P.; Kottowski, H. (to Joint Inst. for Nuclear Research). Luxemburgian Patent 63,599. 23 Jul 1971. vp. (In German).

A heat exchanger for LMFBRs in which a direct contact between incompatible primary and secondary coolants in case of tube failures has to be avoided is described. A hermetically sealed pressure container is partly filled with a working medium. In this medium a tube bundle is dipped which is fed by the primary coolant, whereas above the liquid level of this medium a further tube bundle is arranged, being traversed by the secondary coolant. During operation the working medium performs a natural evaporation-condensation cycle between these bundles. In case of a tube failure the heat exchanger behaves like an intermediate cooling circuit without such expensive parts like pumps which otherwise would be necessary for such a circuit. Different constructive realizations of this heat exchanger concept as well as several detailed improvements are described. (INIS)

17583 MODIFIED ONE-MODE METHOD FOR FAST-REACTOR DIFFUSION CALCULATIONS. Kiguchi, T. (Hitachi, Ltd., Kawasaki, Japan). Nucl. Sci. Eng.; 53: No. 1, 112-120(Jan 1974).

The modified one-mode method for fast-reactor neutron diffusion calculations was formulated by collapsing two- or three-energy-mode synthesis equations to an effective one-mode equation. The calculational procedure consists of solving an eigenvalue problem to determine the effective neutron multiplication factor and the first-mode expansion coefficient, and solving inhomogeneous problems to determine the higher mode expansion coefficients. Therefore, the computer running time nearly equals that of the conventional one-group eigenvalue problem. The accuracy of this method was investigated by comparing the results obtained by a modified one-mode method with reference 26-group calculations, employing a one-dimensional radial model of a commercial fast breeder reactor. The discrepancies between the modified one-mode method based on three-mode synthesis and the 26-group method are <0.1% in the effective multiplication factor, 5% in the control-rod reactivity and <2% in the power distribution. These results assure the applicability of this method to fast-reactor design studies. (auth)

17584 FUEL ELEMENT FOR NUCLEAR REACTORS. (to Commission of the European Communities). Dutch Patent 7,114,862. 28 Oct 1971. vp. (In Dutch).

In a fuel element for a breeder wherein the breeding material is disposed centrally and is surrounded by the fissile material it is advantageous, if the breeding material is an oxide, carbide, or nitride of an actinide, to add a small percentage of actinide metal to the breeding material. The metal serves as a getter for the free oxygen, carbon or nitrogen respectively, liberated when the reactor is in use, and while the fissile material under that circumstances has a higher temperature than the breeding material migration of the metal is avoided. (INIS)

17585 IRRADIATION EXPERIMENTATION IN FAST REACTORS. Proceedings of the American Nuclear Society Topical Meeting, Jackson Hole, Wyoming, September 10-12, 1973. Hinsdale, IL; American Nuclear Society (1973). 508p. (CONF-730910-).

Information on fast reactor irradiation experiments is presented under the following headings: fast flux irradiation programs; new developments in fast flux irradiation facilities; design and installation of irradiation experiments; developments in monitoring fast reactor core environment; and effects of irradiation experiments on fast reactor operation and core environment. Separate abstracts are included for 24 of the 31 papers presented. Seven of the papers have been previously abstracted and included in NSA. The seven papers can be located in the NSA Report Number Index under the following report numbers: LA-UR-73-1000; HEDL-SA-860; LA-UR-73-815; HEDL-SA-558; HEDL-SA-556; KAPL-P-4005; and HEDL-SA-555. (DCC)

For abstracts of individual papers see: 17586-17593, and 17630-17645.

17586 FAST FLUX IRRADIATION PROGRAM IN THE UNITED STATES. Simmons, J. M.; Fox, J. E. (Atomic Energy Commission, Washington, DC). pp 3-22 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The USAEC fast flux irradiation program supporting the development of fuels and other reactor materials for use in demonstration and commercial fast breeder reactors is described. The fast flux irradiation experiments conducted during a recent 15-month period are discussed. Summaries are given for the irradiation experiments containing mixed-oxide fuels, advanced fuels, cladding and structural materials, and control rod materials. Discussion of the mixed-oxide fuels irradiation program includes statistical prototypic experiments, fuel performance experiments, general performance scoping experiments, grid-type subassembly experiments and run-to-failure experiments. (19 references) (auth)

17587 UNITED KINGDOM IRRADIATION PROGRAMME IN SUPPORT OF FAST REACTOR DEVELOPMENT. Pounder, J. O. (United Kingdom Atomic Energy Authority, Risley, Eng.); Bagley, K. Q.; Murgatroyd, R. A.; Harries, D. R.; Parkinson, N. pp 23-34 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The United Kingdom irradiation programme for fuel, fuel pins and subassemblies, core structural and cladding materials and absorber materials is described. The bulk of this programme is currently being carried out in DFR with some irradiations, particularly on fuel in MTR. The plans for a considerable programme in PFR are outlined. A brief description of the facilities available for irradiation experiments in DFR and PFR is presented. (4 references) (auth)

17588 FAST FLUX IRRADIATION PROGRAM DEVELOPMENT OF THE FRENCH LMFBR. Moranville, C. (CEA, Paris). pp 35-53 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The irradiation test programs for stainless steel clad PuO_2-UO_2 fuel pins are reviewed. Programs for the Rapsodie reactor and planned programs for the Phenix reactor are described. (DCC)

17589 THRESHOLD OF FUEL ELEMENT TECHNOLOGY FOR SNR: REFLECTIONS ON THE STATUS OF DEVELOPMENT FOR FAST REACTORS. Karsten, G. G. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 54-77 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The present special situation of the fuel element development for the SNR can be characterized as a status of transition from basic research to technological realization. This means that the finalization of the specifications for the fuel elements of the SNR 300 will be the next step. The main areas of the past years of research and their results are presented. Fuel, cladding, pin and the fuel element will be the subjects of discussion. However, it will be necessary to reflect also upon the degree of perfection under aspects of the requirements for fuel elements of commercial breeder reactors of the generation which follows the demonstration plants. (10 references) (auth)

17590 FUEL AND MATERIALS IRRADIATION TEST PROGRAM AND POST IRRADIATION EXAMINATION FACILITIES IN PNC. Uematsu, K.; Ishida, Y.; Kashihara, H.; Kawata, T. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). pp 78-101 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The current status of Japanese irradiation programs for fast reactor fuel and materials is described for the "JOYO" experimental fast reactor and "MUNJU" proto type fast reactor. The current status of PNC's post irradiation examination facilities are also described. (auth)

17591 STRUCTURAL EVALUATION OF LMFBR GRID-SPACED ASSEMBLY DESIGN IN EBR-II. Atcheson, D. B.; Kaplan, S. (General Electric Co., Sunnyvale, CA). Contract AT(04-3)-893. pp 257-266 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

Two experimental grid-spaced fuel subassemblies using the wave beam grid spacer concept are currently undergoing irradiation in EBR-II. The tests are referred to as diagnostic assembly tests in the sense that they have been designed to simulate design-limiting conditions in the LMFBR. Grid spacer subassembly design and design methods can be evaluated and improved based on a comparison of the predicted performance with the actual grid spacer subassembly performance observed during the interim and post-irradiation examinations. (auth)

17592 EXPERIENCE WITH A THERMOCOUPLE WORKING WITH ZERO TIME CONSTANT. Cambillard, E. (CEN, Saclay, France); Huetz, J.; Lions, N. pp 286-288 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The use of steel–sodium thermocouples in fast sodium–cooled reactors is analyzed. The performance of the steel–sodium thermocouple is verified in the Rapsodie reactor. The e.m.f. calibration curves between sodium and different kinds of steel are presented. (DCC)

17593 APPLICATIONS OF MECHANICAL INTERACTION DATA FROM EBR-II TEST RODS TO NEAR-TERM LMFBR. Hilbert, R. F.; Kangilaski, M.; Appleby, W. K.; Craig, C. N. (General Electric Co., San Jose, CA). pp 472-483 of Irradiation Experimentation in Fast Reactors.

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

Data obtained from EBR-II test rods clad in solution annealed Type 316 stainless steil are shown to provide a close simulation of the timing and extent of fuel-induced cladding strain to be expected using cold-worked Type 316 stainless steel cladding in near-term LMFBR's. The mechanical interaction in cold-worked Type 316 stainless steel clad fuel rods in an LMFBR is projected using cladding strain data from higher swelling solution annealed Type 316 stainless steel clad rods that operated at a relatively low fluence to burnup ratio in EBR-II. A comparison of the projected cladding strain history with the anticipated cladding ductility indicates that fuel-induced cladding inelastic strain may be lifetime limiting and should be considered in the design of cold-worked Type 316 stainless steel clad mixed-oxide fuel rods for near-term LMFBR's. (11 references) (auth)

17594 DEVICE FOR THE LEAK-TIGHT ASSEMBLY OF HEAT EXCHANGERS IN NUCLEAR REACTORS. Vercasson, M. (to Commissariat a l'Energie Atomique). US Patent 3,784,443. 8 Jan 1974. Priority Date 7 Aug 1970, France. 4p.

A leak-tight passage is provided for a heat-exchanger shell within an opening formed in the primary vessel wall of a fast reactor. The opening comprises a vertical cylindrical collar surmounted by an annular bell which is rigidly fixed to the heat-exchanger shell and shaped so as to constitute in conjunction with the collar an annular space between the cylindrical collar an annular bell which is maintained unprimed by injecting a gas under pressure into this space. (auth)

17595 HEAT TRANSFER TO LIQUID METAL HEAT TRANSFER MEDIA FOR NUCLEAR POWER STATIONS. Andreev, P. A.; Borishanskii, V. M.; Firsova, E. V. Heat Transfer–Sov. Res.; 5: No. 6, 13-18(1973).

Recommendations are made with respect to the calculation of heat transfer in the units of nuclear power stations cooled by liquid metals (tubes, annular channels, bundles of rods). The calculation formulas cover a wide range of flow conditions (from laminar to fully developed turbulent flow). (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 15675, 15723, 16118, 16396, 17116, 17573, 17575, 17580, 17581, 17585, 17586, 17590, 17591, 17735, 17736, and 17909.

17596 (BNWL-SA-4846) ENGINEERING SCALE TEST OF AN FFTF FISSION GAS DELAY BED. McElroy, J. L.; Kabele, T. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 12p. (CONF-731101-49). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

17597 (EIR-242) STARTUP OF DIORIT II REACTOR. Flury, H.; Jeschki, W.; Nechvatal, L. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1973. 91p. (In German). Dep. NTIS (U. S. Sales Only) $6.75.

The measurements made during the startup of the DIORIT II reactor are reported and discussed. These measurements include those made at low power, thermal and hydraulic measurements, and measurements made on the sensitivity of the uranium jacket monitoring and the sensitivity of the new shielding system. Sharp deviations are found between the calculated and measured values of the moderator temperature coefficient and the level coefficient. (JSR)

17598 (HEDL-TME-73-5(Vol. 3)) HEDL QUARTERLY TECHNICAL REPORT, JULY, AUGUST, SEPTEMBER 1973. Volume 3. Engineering and Development. Noordhoff, B. H.; Weber, S. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2170. 196p. AT.

The test program for FFTF components and equipment is described. The development and testing activities for FFTF measurement and control systems are summarized. FFTF systems engineering is highlighted. Extensive data for test program engineering and measurement and control studies are presented in appendices. (JWR)

17599 (IAEA-147) RESEARCH REACTOR UTILIZATION. Proceedings of a Study Group Meeting on Research Reactor Utilization, Bandung, Indonesia, August 2–6, 1971. (International Atomic Energy Agency, Vienna (Austria)). 1972. 385p. (In English and French). (CONF-710857-).

Information on the utilization of research reactors is presented under the following general headings: status reports; research reactor utilization in engineering; and use of reactor neutron beams for research. Separate abstracts are included for each of the 25 papers presented. (DCC)

For abstracts of individual papers see: 17548, 17600–17621, 17735, and 17736.

17600 (IAEA-147, pp 17-19) STATUS REPORT ON THE CURRENT ACTIVITIES AND FUTURE PLANS OF THE OFFICE OF ATOMIC ENERGY FOR PEACE, BANGKOK, 1971. Pumlek, R. (Office of Atomic Energy for Peace, Bangkok). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Information is presented concerning the current scientific activities and future plans utilizing the Thai Research Reactor (TRR-1). Presently radioisotope production seems to be the main utilization of the reactor. (auth)

17601 (IAEA-147, pp 21-32) REPORT ON THE STATUS AND FUNCTIONS OF THE TSING-HUA OPEN-POOL REACTOR. Cheng, C. H.; Yang, C. M. (National Tsing Hua Univ., Hsinchu, Taiwan). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The various functions and applications of the Tsing Hua Open-pool Reactor which has been in use in Taiwan since 1961 are described. The three main functions of the reactor include: education and training purposes; research and development; and practical applications, especially radioisotope production and irradiation services. A list of thesis work based on use of the reactor is given. (auth)

17602 (IAEA-147, pp 33-39) STATUS REPORT OF THE BANDUNG REACTOR CENTRE. Soepadi, S.; Subki, I.; Surjadi, A. J. (Bandung Reactor Centre, Indonesia). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The Bandung Reactor Center was commissioned in the beginning of 1965 and it took almost two years since then to be actively engaged in its present activity. The initial activities were emphasized on training, isotope production and research on related problems. These efforts were then followed by adaptation to research and to a smaller extent research in physics and chemistry. The current activities cover: continuous operation of the reactor of three days a week to support isotope production and beam-port experiments; health physics activities comprising radiation protection in hot laboratories, waste management, fallout measurements, intercalibration of film badges with the IAEA and the Bhabha Atomic Research Centre/India; production of radioisotopes for nuclear medicine and nuclear hydrology activities; construction of a hot cell facility to handle high activity gamma sources; routine neutron activation analysis of mineral ores and deposits; and neutron spectrometry. (auth)

17603 (IAEA-147, pp 41-74) UTILIZATION OF PAKISTAN'S RESEARCH REACTOR (PARR). Butt, N. M. (Pakistan Inst. of Nuclear Science and Tech., Nilore). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The research program under execution at PARR (Pakistan Research Reactor) at the Pakistan Institute of Nuclear Science and Technology in Nilore, Rawalpindi, is described. The utilization of the 5 MW Swimming Pool Research Reactor in the field of solid state physics, nuclear physics, radioisotope production and activation analysis is discussed. Some recent results of the various research projects currently under investigation are reported. Further research work envisaged is mentioned. (auth)

17604 (IAEA-147, pp 75-81) STATUS REPORT ON PRR-1. Ibe, L. D. (Philippine Atomic Energy Commission, Manila). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The PRR-1 is the principal facility used for the advancement of atomic energy activities in the Philippines. It is utilized for isotope production, sample irradiations, and conduct of experiments in the nuclear sciences and engineering and training of personnel. Research programs aimed at increasing the utility of PRR-1 and insuring its safety are described. (auth)

17605 (IAEA-147, pp 83-98) STATUS REPORT OF THE ENGINEERING PROGRAMS AND PROPOSED USE OF THE KOREAN TRIGA RESEARCH REACTORS IN SUPPORT OF POWER REACTOR FUEL DEVELOPMENT. Lee, B. W. (Atomic Energy Research Inst., Seoul). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The current status of the engineering programs on the use of Korean TRIGA research reactors is summarized. The major effort of the research and development for nuclear power in Korea is the power reactor fuel development. In this connection, the method for the activated sintering of UO_2 pellets by TiO_2 addition was developed. In order to test any adverse effect on radiation stability and behavior of UO_2 pellets due to TiO_2 addition, the TRIGA Mark III King Furnace is proposed for this application. The method for activated sintering is described. The prospect of the in-core irradiation using the TRIGA Mark III reactor, particularly on the effect of TiO_2 addition to UO_2, is discussed. (4 references) (auth)

17606 (IAEA-147, pp 145-191) ENGINEERING AND USE OF RESEARCH REACTORS AT THE GRENOBLE NUCLEAR RESEARCH CENTRE. Merchie, F. (Nuclear Research Centre, Grenoble, France). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Almost all irradiation programs in France are carried out in swimming pool-type reactors. After summarizing those characteristics of swimming pool reactors which are advantageous in the development of nuclear techniques, the general characteristics of the SILOE, MELUSINE and SILOETTE reactors at the Grenoble Nuclear Research Center are presented. The successive improvements made in these reactors are described. The principal types of irradiation devices which have been developed over the last few years and their applications are discussed. (auth)

17607 (IAEA-147, pp 193-209) UTILIZATION OF A RESEARCH REACTOR AS PREPARATION FOR THE INTRODUCTION OF NUCLEAR POWER. Wood, A. C. 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

In order to successfully introduce nuclear power a developing country needs a group of project oriented experienced nuclear engineers. Because the national institutions are usually scientifically oriented and the conventional power station engineers are not familiar with nuclear problems it is desirable to form a composite team which is given a project as a prelude to the construction of the nuclear power station. A number of project types are described ranging from the construction of a small prototype power station to an engineering loop. An example is given of a project concerning a modification to the Australian research reactor HIFAR. Emphasis is laid on the need for a project to result in new hardware or a change to existing hardware if the experience obtained is to be relevant to the construction and operation of a nuclear power station. (auth)

17608 (IAEA-147, pp 211-230) ENGINEERING PROGRAMS INVOLVING RESEARCH REACTORS. Koch, L. J. (Argonne National Lab., IL). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Research reactors provide an effective focal point for a broad spectrum of nuclear engineering activities. Many of these activities can provide excellent reactor engineering preparation for the introduction of nuclear power systems. Effective engineering programs include the participation of engineers in all the activities related to the research reactor program. These activities should include: maintenance, improvement and modification of the reactor and experimental facilities; engineering development of "non-engineering" reactor experiments; and a broad program of engineering experiments. A program of this type will assure the participation of the engineering staff at the research reactor facility (irrespective of the number of engineers in the group) in virtually all of the activities at the facility. This will result in the best utilization of the total technical staff and the best preparation of the engineering staff for future reactor engineering responsibility. It should also result in the most effective utilization of the research reactor and the most productive research program. (auth)

17609 (IAEA-147, pp 231-247) RESEARCH REACTOR UTILIZATION ENGINEERING WORK IN SUPPORT OF A NUCLEAR POWER PROGRAM. Mehta, S. K.; Sastry, S. R. (Bhabha Atomic Research Centre, Trombay, India). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The Department of Atomic Energy of India has committed itself to a definite program of building a series of nuclear power plants in India. This program calls for a supporting development program. The facilities available at Trombay for carrying out in-reactor engineering experiments are described. The utilization of these facilities and the programs on hand are outlined. (7 references) (auth)

17610 (IAEA-147, pp 249-257) POWER UPGRADING OF THE TRIGA MARK II REACTOR FROM 250 kW TO 1000 kW. Soepadi, S.; Subki, I.; Linggoatmodjo, K. (Bandung Reactor Centre, Indonesia). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The current utilization of the TRIGA Mark II reactor and its future program are described. Upgrading the reactor power to 1000 kW will increase its capacity to supply isotopes for various applications and significantly support the research and engineering programs related to the reactor. The major modifications to the reactor as well as the phases of the upgrading are also described. The modifications, installations, criticality and commissioning tests will be executed by the local staff. (auth)

17611 (IAEA-147, pp 259-270) OPERATING EXPERIENCE WITH PRR-1. Ibe, L. D. (Philippine Atomic Energy Commission, Manila); Corpus, G. C. 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The Philippine research reactor PRR-1 became critical in 1963. After one year of testing and low-power operation, the reactor was brought to full power of one megawatt. The PRR-1 is utilized for radioisotope production, sample irradiations, physics experiments and training of personnel. Some operational difficulties encountered are also discussed. (auth)

17612 (IAEA-147, pp 271-280) SIX YEARS OPERATING EXPERIENCE WITH THE TRIGA MARK II REACTOR AT THE BANDUNG REACTOR CENTRE. Subki, I.; Linggoatmodjo, K. (Bandung Reactor Centre, Indonesia). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The utilization, operation and maintenance of the TRIGA Mark II reactor at the Bandung Reactor Center are described. The reactor is utilized for isotope production and its research application is

increasing steadily every year. The main reactor operation problems come from instrument failure or from the rotary specimen rack. No safety hazard to the surrounding population and personnel has occurred since its first criticality in 1964. The total integrated reactor power up to the present is about 2×10^6 kW-hours. (auth)

17613 (IAEA-147, pp 281-288) VIETNAM TRIGA MARK II REACTOR MAINTENANCE: TROUBLES WITH THE ROTARY SPECIMEN RACK ASSEMBLY. Ton That Con; Ngo Dinh Long. (Dalat Nuclear Research Center, Vietnam). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The many difficulties encountered in operating the Rotary Specimen Rack (RSR) of the Triga Mark II Reactor installed in the Dalat Nuclear Research Center are described. Diagnosis of troubles, the vain attempt to repair it, and the steps followed to install a new RSR are described. (auth)

17614 (IAEA-147, pp 289-293) CURRENT STUDIES UTILIZING THE NEUTRON CRYSTAL SPECTROMETER. Chatraphorn, S.; Nimwanadon, T. (Office of Atomic Energy for Peace, Bangkok). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The present status of the research group utilizing the neutron crystal spectrometer is described. The influence of the collimator geometry on the flux at the specimen position is studied. The experimental results agree very well with the calculations. (auth)

17615 (IAEA-147, pp 295-299) STATUS REPORT ON EXPERIMENTS UTILIZING REACTOR NEUTRON BEAMS AT AERI. Kim, H. J. (Atomic Energy Research Inst., Seoul). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The limitations encountered in AERI to perform experimental work on neutron and solid state physics with the TRIGA Mark II reactor are discussed. The TRIGA Mark III reactor presently under construction is described. Progress and present status of the activities carried on related to the transfer of research equipment to the Mark III reactor by the groups devoted to radiative capture spectrometry, neutron diffraction, neutron scattering, and neutron radiography are reported. (auth)

17616 (IAEA-147, pp 301-321) PLAN FOR THE CONSTRUCTION OF SLOW NEUTRON SPECTROMETERS IN THE AERI (DESIGN OF AN INVERTED FILTER SPECTROMETER). Kim, H. J.; Kim, H. K.; Yoon, B. G. (Atomic Energy Research Inst., Seoul). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The design work for the inverted filter spectrometer, which is currently under construction and will be installed at the TRIGA Mark III reactor in the AERI, is outlined. Using a copper crystal monochromator the instrumental parameters are determined, and some characteristics, e.g., energy resolution, incident beam flux at the specimen position and the second order content, are estimated. Also, some considerations for the analyzing filter and the correction of second order contamination are discussed. (17 references) (auth)

17617 (IAEA-147, pp 323-330) NEUTRON BEAM EXPERIMENTS AT TROMBAY. Dasannacharya, B. A. (Bhabha Atomic Research Centre, Bombay). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Neutron beam experiment work done at the CIRUS reactor for a decade and future plans are described. Solid state and fission physics research is discussed. Spectrometer modifications and construction of a 100 MW reactor at Trombay and a pulsed reactor at Madras are mentioned as part of the major effort put towards materials irradiation for fast reactor design. (11 references) (auth)

17618 (IAEA-147, pp 331-352) NEUTRON CRYSTAL SPECTROMETERS AT THE BANDUNG REACTOR CENTRE. Linggoatmodjo, K.; Amilius, Z. (Bandung Reactor Centre, Indonesia). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

A neutron diffractometer has been constructed and installed at the tangential beam port of the TRIGA MARK II reactor. A detailed description of the spectrometer together with the associated electronic counting set-up and other accessories is given. The neutron beam spectrum from the beam port was determined and calibrated. Neutron diffraction patterns of polycrystalline Ni and Fe were observed. Comparison between the observed relative intensities and the (111)-peak of Ni and the calculated ones shows a good agreement. Some preliminary results with the neutron diffraction on NiO powder using this spectrometer are given. A short account is given about the construction progress of an inverted filter spectrometer (beryllium detector spectrometer). (9 references) (auth)

17619 (IAEA-147, pp 353-362) DESIGN AND POSSIBLE UTILIZATION OF A NEUTRON GUIDE TUBE BISMUTH FILTER ON A BEAM HOLE EXPERIMENT AT THE 1 MW TRIGA MARK II REACTOR. Jatiman, S.; Surjadi, A. J.; Supadi, S. (Bandung Reactor Centre, Indonesia). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

The use of a totally reflecting guide tube for low energy neutrons can produce a high intensity neutron beam with reasonable collimation. Use of a bismuth filter in the biological shielding is needed to attenuate fast neutrons and gamma rays. Moreover, (111)-oriented Bi-single crystal filters have shown good transparency for $\lambda > 4$ Å and also reasonable transparency for $\lambda \leq 4$ Å. Thus, a lot of experiments like small angle scattering, studies of crystal properties, total cross section determination and so on can be designed utilizing a bismuth filter neutron guide tube. (6 references) (auth)

17620 (IAEA-147, pp 363-371) NEUTRON SPECTROMETRY RESEARCH AT PARC. Natera, M. G.; Navarro, Q. O. (Philippine Atomic Research Center, Quezon City). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Current research activities on neutron spectrometry at the Philippine Atomic Research Center are reported. Several related activities which include the construction, installation and improvement of ancilliary facilities are also briefly reported. A list of previous reports on neutron spectrometry research at PARC is given. (auth)

17621 (IAEA-147, pp 373-376) REPORT ON THE BEAM PORTS UTILIZATION OF THE TSING HUA OPEN POOL REACTOR. Cheng, C. H.; Yang, C. M. (National Tsing Hua Univ., Hsinchu, Taiwan). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Experiments utilizing the THOR beam ports are described. These experiments include: fuel burnup determination by measuring the neutron age after colliding with the bombarded elements; determination of the thermal neutron spectrum by the chopper and time of flight technique; capture gamma measurement; ore analysis by the delayed neutron method; and fast neutron spectrum determination using a $^6Li_3$ neutron detector and the coincidence counting technique. (5 references) (auth)

17622 (INIS-mf-773) REMODELLING OF THE ARGONAUT REACTOR. Aghina, L. O. B.; Bellini, I. W. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1971. 37p. (In Portuguese). INIS.

The main works and modifications performed on the Argonaut reactor of the Instituto de Engenharia Nuclear after 4 years of operation are described. New positioning and holding system for the fuel elements and graphite wedges for the reactor brought appreciable stability to the operation. The removal of the plastic layer, printing and inspection of the corrosion of the elements plater are also described. (INIS)

17623 (INIS-mf-774) SUBCRITICAL UNITY FOR THE ARGONAUT REACTOR. Mongiovi, G.; Aghina, L. O. B. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil). Divisao de Reatores). Apr 1971. 45p. (In Portuguese). INIS.

H_2O-UO_2 (natural) grids calculations were performed for tube-type fuel elements aiming at the construction of a subcritical unit employing the internal thermal column of an Argonaut reactor as a source. The results confirmed the feasibility of the use of natural UO_2 for the proposed arrangement as long as one has a strong source or a subcritical unit diameter greater than 100 cm. (INIS)

17624 (INIS-mf-775) MEASUREMENT OF THE TRANSFER FUNCTION OF ARGONAUT REACTOR. Beltramino, A. R. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Jan 1970. 18p. (In Spanish). INIS.

Transfer function of the IEN-R1 Argonauta Reactor is measured. Complete equipment for reactivity pulsing is described. (INIS)

17625 (INIS-mf-779) ARGONAUT REACTOR: MEASUREMENT OF THE MODERATOR (H_2O) TEMPERATURE WITH A THERMISTOR BRIDGE. de Amorim Marino, R. C. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil). Divisao de Reatores). [nd]. 24p. (In Portuguese). INIS.

A temperature measuring device, employing a thermistor sensing probe and a Wheatstone bridge, was developed and used for the measurement of water temperatures in an Argonaut reactor. The electronic circuit and experimental data are presented. (INIS)

17626 (N-73-24662) CAVITY TEMPERATURE AND FLOW CHARACTERISTICS IN A GAS-CORE TEST REACTOR. Putre,

H. A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jun 1973. 27p. (NASA-TM-X-2797). NTIS $3.00.

A test reactor concept for conducting basic studies on a fissioning uranium plasma and for testing various gas-core reactor concepts is analyzed. The test reactor consists of a conventional fuel-element region surrounding a 61-cm-(2-ft-) diameter cavity region which contains the plasma experiment. The fuel elements provide the neutron flux for the cavity region. The design operating conditions include 60-MW reactor power, 2.7-MW cavity power, 200-atm cavity pressure, and an average uranium plasma temperature of 15,000°K. The analytical results are given for cavity radiant heat transfer, hydrogen transpiration cooling, and uranium wire or powder injection. (auth)

17627 (NP-19918) O.E.C.D. HIGH TEMPERATURE REACTOR PROJECT DRAGON FOURTEENTH ANNUAL REPORT, 1972–1973. (Organization for Economic Co-Operation and Development, 75 – Paris (France)). 112p.

Research programs, maintenance requirements, and operations of the Dragon Reactor are reviewed. Fuel and graphite irradiation programs are discussed. Administrative activities during April 1972 to March 1973 are reviewed. (DCC)

17628 (ORNL-TM-4367) TEMPERATURE DISTRIBUTION IN A 19-ROD SIMULATED LMFBR FUEL ROD BUNDLE WITH INLET BLOCKAGES (FFM BUNDLE 2B). Fontana, M. H.; Kress, T. S.; MacPherson, R. E.; Wantland, J. L.; Gnadt, P. A.; Parsly, L. F. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 251p. AT.

Thermal-hydraulic results are presented for a sodium-cooled bundle of 19 electrically heated rods that simulate the fuel of the Fast-Flux Test Facility (FFTF). Test conditions include flows with all 42 subchannels unblocked and with inlet blockage plates covering 13 and 24 centrally located subchannels respectively. Over the flow range tested (10 to 60 gpm) the total bundle pressure drop was not affected significantly by the presence of either blockage plate. We found that centrally located inlet blockages of up to approximately half of the flow area of the 19-rod bundle with a 3-in. unheated entrance length do not result in excessively high temperatures. The temperature increases attributed to the inlet blockages are of the same order as temperature variations normally observed in unblocked bundles. (auth)

17629 (SLA-73-876) SANDIA PULSED REACTOR III (SPR III): NEUTRON PHYSICS CORE CALCULATIONS. Schmidt, T. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 23p. Dep. NTIS $3.25.

Neutron transport calculations performed in support of the SPR III design are described. Calculations were made using the TWOTRAN two-dimensional, multigroup, discrete ordinates code. Several core models were used in describing the SPR III annular configuration. Critical dimensions, performance characteristics, and component reactivity worths were determined. (JWR)

17630 NEW DEVELOPMENTS IN FAST FLUX IRRADIATION FACILITIES IN BR-2. Michel, A. (Societe Belge pour l'Industrie Nucleaire, Brussels); Vanmassenhove, G.; Detavernier, W. pp 105-118 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The irradiations in sodium cooled closed loops under cadmium screen in the material testing reactor BR 2 at CEN/SCK in Mol (Belgium) are defined. After a brief description of the most advanced loop of this series IPSL-500 kW (irradiation "Mol 7B"), the problems raised by the analysis of the in-pile conditions are discussed. (auth)

17631 NEW DEVELOPMENTS IN IRRADIATION FACILITES IN EBR-II. Hutter, E.; Rice, R. E.; Seim, O.; Smaardyk, A.; Winkleblack, R. K. (Argonne National Lab., IL). pp 119-136 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The Experimental Breeder Reactor II was designed and built as the original power plant to demonstrate the sodium-cooled fast-breeder reactor concept. It followed the first fast-breeder reactor experiment, EBR-I, which was NaK-cooled and which operated the first turbine-generator to produce electric power from nuclear fission. All experimenters participating in the liquid-metal-fast-breeder development program know that the EBR-II has been operating as a test reactor since successfully completing its original mission, and that EBR-II is the only sodium-cooled fast-flux test facility currently operating in the U. S. program. The special irradiation facilities that have been developed to facilitate the use of the EBR-II as a test reactor are described and capabilities with applications are indicated. (auth)

17632 IRRADIATION TEST CAPABILITIES OF THE FFTF. Schively, D. P. (Hanford Engineering Development Lab., Richland, WA). pp 137-165 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The Fast Flux Test Facility (FFTF) will be the primary irradiation test facility for the US LMFBR program. The central feature of the FFTF is the fast test reactor (FTR) which will provide a high-intensity, hard-spectrum, fast neutron flux for irradiation testing of fuels and materials to be used in future fast breeder power reactors. As many as eight core positions will be available for contact instrumented tests. These test positions present an ultimate capability of six installed closed loops, each with a thermal rating of 4.3 MW(t). The characteristics of the instrumented test positions are discussed together with the irradiation test vehicles which are being designed to utilize these positions. (auth)

17633 ROLE OF THE KNK-II FACILITY FOR THE DEVELOPMENT OF SNR FUEL SUBASSEMBLIES. Mayer, H.; Andrae, H. (INTERATOM GmbH, Bensberg, Ger.). pp 166-185 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

After a short summary on the KNK plant and on the SNR fuel, a survey is given of the KNK II Core which is part of the development program for SNR fuel subassemblies. The core, its main characteristics and design features are described, the experimental character of the subassemblies are stressed and the further development is outlined. (7 references) (auth)

17634 IRRADIATION FACILITIES AND IRRADIATION EXPERIMENTATION IN RAPSODIE. Bel, A.; Berger, J. (CEN, Cadarache, France). pp 198-207 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The irradiation facilities and the irradiation devices most commonly used in the Rapsodie reactor are described. The nominal data and main features of the reactor are reviewed. Standard irradiation capsules and subassemblies, as well as some rigs used in the central hole of the reactor, are described. Some data are given about experiments performed in Rapsodie. (auth)

17635 DESIGN OF IRRADIATION EXPERIMENTS FOR DFR AND PFR. Pounder, J. O. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 211-228 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

Details are given of the principal irradiation facilities which exist in the Dounreay Fast Reactor (DFR) and in the Prototype Fast Reactor (PFR). The designs of the main types of irradiation experiments provided or to be provided for these reactors are then described. (4 references) (auth)

17636 EXPERIMENTAL GRID-TYPE SUBASSEMBLIES FOR IRRADIATION IN EBR-II. Levine, P. J.; Schwallie, A. L. (Westinghouse Advanced Reactors Div., Madison, PA). Contract AT(11-1)-3045. pp 239-256 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in Fast Reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

Three experimental subassemblies each containing 37 unencapsulated mixed-oxide fuel pins, ahve been designed and fabricated with stainless steel, honeycomb grids as the fuel pin spacer system. The experiments, designated WSA-3, WSA-4 and WSA-8, will provide information on the performance of 20% cold-worked Type 316 stainless steel spot-welded grids and fuel pins at various temperature and fluence levels in flowing sodium for a variety of fuel rod-grid interactions. Variations in fuel rod parameters and operating conditions will provide basic data to test the latest developments in analytical techniques for predicting fuel rod and subassembly behavior. The design, analysis, fabrication and handling of the grid-type subassemblies for EBR-II are described. (12 references) (auth)

17637 FRENCH DEVELOPMENTS IN THE FIELD OF DOSIMETRY FOR IN PILE IRRADIATION EXPERIMENTS. Chaumont, J. M.; Gourdon, J.; Kremser, J.; Bouchard, J.; Campan, J. L.; Genthon, J. P.; Mas, P. (CEN, Cadarache, France). pp 291-313 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

Fuel and materials used in the LMFBR cores are presently tested in irradiation facilities. These irradiations, in order to be representative, should correctly simulate the working parameters of the LMFBR, especially: the temperature range, the linear power and burn up of the fuel, and the integrated flux for the structural materials (cladding, control rods, and shielding materials. . .). Results can be more easily interpreted when the irradiation conditions are well known. A broad view of the methods used, specially power distribution and damage measurement, and some results reached in Rapsodie are presented. (11 references) (auth)

17638 CORRELATION AND INTERPRETATION OF DATA RELATIVE TO EBR-II POWER LEVEL. Golden, G. H.; Gopalakrishnan, A.; Laskiewicz, R. A. (Argonne National Lab., IL). pp 314-332 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

An investigation has been undertaken to determine the difference between the nominal and the actual power at which EBR-II is operated. Three independent approaches have been used in this work: (1) comparisons of heat balances on the primary, secondary, and steam systems, (2) comparison of measured and calculated burnups of fuel specimens irradiated in EBR-II, and (3) hydraulic analyses of the primary system. Results to date indicate that since about run 30, EBR-II has actually been operated at 9 ± 2% below its nominal power. The strongest support for this indication has come from the primary system hydraulic analyses. (14 references) (auth)

17639 ANALYSIS OF DOSIMETRY MEASUREMENTS IN EBR-II AND EBR-II/ZPR-3 CRITICAL. Sehgal, B. R.; Meneghetti, D. (Argonne National Lab., IL). pp 355-382 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

Analyses of an extensive series of reaction rate measurements done recently in the EBR-II Runs 50G and 50H are presented. In addition the reaction rates measured in the EBR-II/ZPR-3 critical assembly No. 60 are analyzed and correlated with those measured in the EBR-II. These analyses were performed with transport theory and diffusion theory codes using detailed representations of the loadings in XY, RZ and XYZ geometry and broad group cross sections derived from the ENDF/B Version 01 and Version 03 data files. It was found that it is possible to predict the measured relative reaction rates quite accurately within the core region, however, there are substantial differences in the radial blanket and axial reflector regions. Analyses of the absolute reaction rates measurements in the EBR-II Run 50H have provided additional evidence that the reactor operates ~9% below the nominal power level of 62.5 MW(t). Differences were observed between the calculated reaction rates using the ENDF/B Versions 01 and 03 data files for the stainless-steel-sodium axial reflector regions in the EBR-II. (11 references) (auth)

17640 EBR-II DOSIMETRY TESTS. Jackson, J. L.; McElroy, W. N.; Uiseth, J. A.; Kellogg, L. S. (Westinghouse Hanford Co., Richland, WA). pp 383-400 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

An extensive full power dosimetry experiment in the EBR-II reactor is described. The result has greatly reduced the uncertainty in the nuclear environment which is essential for interpreting and correlating fuels and materials irradiation experiments for fast reactors. (22 references) (auth)

17641 IN-CORE MONITORING IN THE EXPERIMENTAL BREEDER REACTOR-II. Price, C. C.; Franklin, D. G.; Gopalakrishanan, A. (Argonne National Labl, IL). pp 401-411 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The experience at EBR-II with the development and use of sensors for in-core monitoring in an LMFBR is discussed. Both active and passive sensors are described. Discussion of active sensors include thermocouples, self-powered detectors, and single-subassembly flowmeters. Discussion of passive sensors centers on devices for determining temperatures and gamma heating at locations in-core that are inaccessible to sensors requiring leads and penetration of the primary vessel. (13 references) (auth)

17642 EFFECTS OF DEFECTED FUEL ELEMENTS ON THE OPERATION OF EBR-II. Honekamp. J. R.; Koenig, J. F.; Claar, T. D. (Argonne National Lab., IL). pp 435-455 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

Intentional run-to-cladding-failure (RTF) tests with both the metallic driver fuel and mixed oxide fuel have been conducted in EBR-II. Additional RTF tests are in progress and run-beyond-cladding-failure (RBF) tests are being planned. The modifications to the facility and the method of operation required by this type of fuel testing are discussed. The RTF tests completed to date have all resulted in a slow depressurization of the fuel element gas plenum. The primary effect of these defects on the operation of EBR-II has been a temporary increase in the reactor cover gas activity requiring a reactor shutdown. (14 references) (auth)

17643 EFFECTS OF IRRADIATION EXPERIMENTS ON EBR-II ENVIRONMENT AND OPERATION. Miller, L. B.; Gillette, J. L.; Kirn, F. S. (Argonne National Lab., IL). pp 456-471 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The primary mission of the EBR-II reactor is the irradiation of fast reactor fuels and materials. Approximately 190 different experiments have been or are being irradiated in EBR-II. Because they contain varying amounts of fissile material these experiments significantly affect the neutron-flux, gamma-flux, and power distributions in EBR-II. Each experiment has its own thermalhydraulic characteristics which affects the thermalhydraulic performance of the whole reactor system. The requirements for specified and controlled irradiation conditions for the experiments affects operating parameters such as run length and fuel handling time. (5 references) (auth)

17644 INFORMATION ON THE BEHAVIOR OF THE OXIDE FUEL DRAWN FROM OBSERVATIONS OF THE REACTIVITY DURING THE FIRST DAYS OF POWER OF RAPSODIE–FORTISSIMO. Chaumont, J. M.; Jallade, M.; Martin, J. (CEN, Cadarache, France). pp 484-488 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

Variations of reactivity were carefully measured during the first days of power of Rapsodie's Fortissimo core. Interpretation of these measurements led to a behavior model of the fissile column during a power increase. This model takes into account: a temperature threshold above which the pellets become plastic and which limits the overall dilatation of the columns; and effects of thermal cyclings which progressively reduce the dilatation of the columns to zero. (auth)

17645 FLOW-MODEL STUDIES FOR THE EXPERIMENTAL BREEDER REACTOR-II. Gopalakrishnan, A. (Argonne National Lab., IL). pp 489-501 of Irradiation Experimentation in Fast Reactors. Hinsdale, IL; American Nuclear Society (1973).

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973). See CONF-730910-.

The design and construction of the EBR-II Reactor Hydraulic Test Facility (RHTF) is briefly described. The initial series of flow-modeling experiments at the RHTF is discussed and results presented. Part of these results are comparable with those of an earlier flow-modeling study by the Franklin Institute, and their agreement confirms the satisfactory performance of the RHTF loop and the associated instrumentation. (10 references) (auth)

17646 EFFECT OF NEUTRON INELASTIC SCATTERING ON THE PARAMETERS OF FAST CRITICAL ASSEMBLIES. Vertes,

P. (Kernforschungzentrum, Karlsruhe, Ger.). Nucl. Sci. Eng.; 52: No. 4, 485(Dec 1973).

The influence of the inelastic-scattering, angle-energy correlation effect on the critical parameters of some reactor systems is discussed. The accuracy of a possible approximate treatment is also investigated. Results show that the effect gives a small, but remarkable, correction to the value of k_{eff} and to the reaction rates. (auth)

17647 FINITE ELEMENT ANALYSIS OF SOME CRITICAL FAST ASSEMBLIES. Pitkaeranta, J. (Helsinki Univ. of Tech.); Silvennoinen, P. Nucl. Sci. Eng.; 52: No. 4, 447-453(Dec 1973).

The finite element method is applied in multigroup formalism to the analysis of some fast and intermediate spherical critical systems. The approximation scheme is based on a self-adjoint variational principle associated with the formally self-adjoint form of the monoenergetic transport equation. A number of experimental critical assemblies are analyzed using unmodified and modified Hansen-Roach 16-group cross sections. Comparison of the results with those obtained by S_N calculations indicates that high accuracy is obtained by low-order finite element techniques. Several optional strategies are proposed which may further accelerate the convergence of finite element solutions. (auth)

17648 HETEROGENEOUS EFFECTS OF SODIUM AND ^{238}U AND THE RATIOS OF SOME CROSS-SECTIONS IN BFS-22. Yurova, L. N.; Bushuev, A. V.; Duvanov, V. M.; Kozhin, A. F.; Sirotkin, A. M. At. Energ. (USSR); 35: No. 1, 47(Jul 1973). (In Russian).

The role and magnitude of the effects of the heterogeneous arrangement of materials in the central reactor zone is important in reactor planning. In various zones of a critical assembly BFS-22 the distribution of the U-238 (n, gamma) and Na-23 (n, gamma) reactions was investigated in samples of natural uranium and metallic sodium. The increase in gamma rays from Np-237 and Na-24 was followed. The following reaction cross-section ratios were determined: Na-23 (cap)/U-235(fis), U-238(cap)/U-235(fis), and U-238(fis)/U-235(fis). The Na-23 (cap)/U-235(fis) ratio was calculated to be 0.77×10^{-3}, but found to be 0.580×10^{-3}. The U-238(cap)/U-235(fis) was calculated as 0.134, and found to be 0.128 experimentally. The U-238(fis)/U-235(fis) ratio was calculated to be 0.029, and found to be 0.029 experimentally. The results indicate that in some cases it is necessary to take into account the effects of resonance blocking with a heterogeneous arrangement of materials in the central reactor zone. (SJR)

17649 EFFECTS OF DIFFERENT NUCLEAR COMPUTER CODES AND DATA LIBRARIES ON THE EVALUATION OF THE CRITICAL HTR-EXPERIMENT CESAR II. Scherer, W. (Kernforschungsanlage, Juelich, Ger.). pp 135-145 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 2); CONF-730302-(Vol. 2).

In 1972, an extended experimental program on neutron physics of low-enriched HTR fuel balls was performed in the graphite-moderated critical facility CESAR at CEN Cadarache/France. The experiments were carried out in the framework of a collaboration contract between KFA Juelich and CEA Cadarache. A large part of the measurements was designed for neutron flux mapping throughout the whole reactor. The core had in its center a cavity filled with fuel balls, and several surrounding zones composed of hexagonal graphite blocks with various uranium fuel rods in order to achieve criticality and to adjust the HTR neutron spectrum in the center of the reactor. The experimental results and some well-known computer codes have been compared showing that there are discrepancies not only between experiment and theory but also between the different codes and libraries. As an example the results of the GAMTEREX, MUPϕ and ANISN spectrum calculations in connection with 2-D EXTERMINATϕR reactor calculations, using the GAM-I, the THERMALIZATION, and the DRAGON-5 libraries are reported. As it was possible to combine different codes with the same library, the effects introduced by the different mathematical methods in solving the Boltzmann equation can be discussed separately. The results show that most of the discrepancies concerning the behavior of neutron flux and reaction rates become severe near the boundaries of fuel zones with very different neutron spectra. The eigenvalue of the system differs from code to code by about 2% max. The effects of uncertainties in neutron data seem to be more important than the uncertainties of nuclear computer codes; thus greater attention should be paid to library problems in the future. (auth)

17650 TAPIRO FAST SOURCE REACTOR AS A BENCHMARK FOR NUCLEAR DATA TESTING. D'Angelo, A. (Univ., Calabria, Italy); Martini, M.; Salvatores, M. Energ. Nucl. (Milan); 20: No. 11, 614-621(Nov 1973).

A calculational model of the TAPIRO reactor, of the CNEN Nuclear Studies Center at Casaccia (Rome), suitable for nuclear data testing, is presented. This model was used to analyze the recent ENDF/B-III ^{235}U and Cu cross sections values. The TAPIRO results were compared with analogous results for the GODIVA reactor, of the Los Alamos Scientific Laboratory (USA). Some indications were derived from this comparison for the high-energy ^{235}U, ^{238}U, and Cu cross sections values. (8 tables, 5 figures, 20 references) (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstract 17734.

17651 (HW-57015) PRIMARY COOLANT SYSTEM. 105-N DESIGN CRITERIA. Project CAI-816. Henke, L. G. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 13 Nov 1959. 58p. Dep. NTIS $5.00.

Declassified 4 Apr 1973.

The design and configuration of valves and piping are presented for the N-Reactor primary cooling system. (DCC)

17652 (HW-57044) 100-N DESIGN BASES. Part II. Functional Requirements of the Primary Loop Control and Instrumentation Systems. Project CAI-816. Condotta, D. L. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 11 Sep 1959. 29p. Dep. NTIS $3.50.

Declassified 4 Apr 1973.

The design bases outlining the functional requirements of the instrumentation and control systems of the 100-N reactor primary coolant loop are described. (JWR)

Propulsion and Package Reactors

Refer also to abstracts 15440, 16140, 16194, 17626, 17685, and 17737.

17653 (ANL-6758) NUCLEAR THERMIONIC CONVERTERS FOR SPACE POWER. Carter, J. C.; Ulrich, A. J.; Armstrong, R. H. (Argonne National Lab., Ill. (USA)). Aug 1963. Contract W-31-109-eng-38. 50p. Dep. NTIS $4.50.

Declassified 4 Sep 1973.

Four concepts of nuclear thermionic converters in the megawatt-electrical range are considered as sources of power for satellite power stations and for translunar rocket engines. As far as is known, these four concepts with slight variations cover the area of current conceptual design. Two of the concepts are concerned with a dynamic system in which a liquid metal is used to transfer heat from the nuclear reactor to a radiator. In one concept, the in-core type, the liquid metal is used to transfer heat from the anode of a vapor-filled diode, located in the core, to the radiator. In the other, an in-radiator type, the liquid metal is used to transfer the heat from the reactor to the cathode of a vapor-filled diode located in the radiator. Two of the concepts are concerned with a static system in which the thermionic diodes are mounted on the surface of a cylindrical shell of fissionable material. One concept has a vapor-filled diode and the other a high-vacuum diode. The difficult problems associated with each concept are listed and recommendations made for a long-range plan of research and development. A comparison of the performance data of these four concepts and those of other designers is made. It is concluded that the use of higher heat-rejection temperatures does not greatly affect the weight-to-power ratio of the in-pile and in-radiator thermionic converters. It does, however, make the more reliable, but very heavy, static system much lighter and more attractive in the megawatt-electrical range. (11 references) (auth)

17654 (GESR-2105) DEVELOPMENT OF A NUCLEAR THERMIONIC FUEL ELEMENT. Annual Summary and Twenty-first Quarterly Progress Report, July 1, 1967-September 30, 1967. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). 1967. Contract AT(04-3)-189. 172p. Dep. NTIS $10.75.

Declassified Jun 1973.

Research directed toward the development of a nuclear thermionic fuel element and a compact thermionic reactor system is summarized. The work includes irradiation experiments on representative 3-cell fuel elements, materials development, fabrication studies, and post-irradiation examination of materials. (JWR)

17655 (GESR-2112) THERMIONIC FUEL ELEMENT IN-PILE TEST TECHNIQUES. Clark, A. F. Jr.; Gilliland, D. L.

(General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). Jun 1968. Contract AT(04-3)-189. 81p. Dep. NTIS $6.25.

Declassified Jun 1973.

A program of research and development has been directed toward the development of a nuclear thermionic fuel element and a compact thermionic reactor system under AEC Contract AT(04-3)-189, Project Agreement 32. A major focus of this program has been on the irradiation of representative three-cell thermionic fuel elements (TFEs), and the development of materials and components through irradiation of single-cell-in-pile converters (SCIPs) in the General Electric Test Reactor (GETR). In-pile testing techniques used for the irradiation of SCIPs and TFEs are described. These techniques are continuously evolving; a current status is presented. (11 references) (auth)

17656 (GKSS-73-E-16) MEASUREMENTS OF WATER CONTENT OF STEAM AND DRAINAGE WITHIN THE WET STEAM REGIME OF THE TURBINE. Research Report No. 16. Boie, H.; Holz, B. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1973. 40p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

Measurements of drainage and water content of steam are presented in order to gain some information on the expansion conditions within the main turbine of the N.S. "Otto Hahn." Due to the low superheating, expansion occurs already after the first two to three stages in the wet steam regime, and as the content of water increasing during expansion reduces the efficiency of the turbine, the water has to be removed through appropriate drainage devices in order to prevent erosion damage to the turbine blading due to drop formation. The measured data are used to determine whether and to what extent the constructional design of the turbine meets the requirements of wet steam separation. (GE)

17657 (N-73-20735) EXPERIMENTAL DETAILED POWER DISTRIBUTION IN A FAST SPECTRUM THERMIONIC REACTOR FUEL ELEMENT AT THE CORE/BeO REFLECTOR INTERFACE REGION. Klann, P. G.; Lantz, E. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 19 Mar 1973. 52p. (NASA-TM-X-68207). NTIS $4.75.

A zero-power critical assembly was designed, constructed, and operated for the purpose of conducting a series of benchmark experiments dealing with the physics characteristics of a UN-fueled, Li-7-cooled, Mo-reflected, drum-controlled compact fast reactor for use with a space-power conversion system. The critical assembly was modified to simulate a fast spectrum advanced thermionics reactor by: (1) using BeO as a reflector in place of some of the existing molybdenum, (2) substituting Nb-1Zr tubing for some of the existing Ta tubing, and (3) inserting four full-scale mockups of thermionic type fuel elements near the core and BeO reflector boundary. These mockups were surrounded with a buffer zone having the equivalent thermionic core composition. In addition to measuring the critical mass of this thermionic configuration, a detailed power distribution in one of the thermionic element stages in the mixed spectrum region was measured. A power peak to average ratio of two was observed for this fuel stage at the midplane of the core and adjacent to the reflector. Also, the power on the outer surface adjacent to the BeO was slightly more than a factor of two larger than the power on the inside surface of a 5.08 cm (2.0 in.) high annular fuel segment with a 2.52 cm (0.993 in.) od and 1.86 cm (0.731 in.) id. (auth)

17658 (N-73-22624) PRELIMINARY PLAN FOR TESTING A THERMIONIC REACTOR IN THE PLUM BROOK SPACE POWER FACILITY. Haley, F. A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). [1972]. 24p. NTIS $3.25.

A preliminary plan is presented for testing a thermionic reactor in the Plum Brook Space Power Facility (SPF). A technical approach, cost estimate, manpower estimate, and schedule are presented to cover a 2 year full power reactor test. (auth)

17659 (N-73-23726) S8DR SHIELD EXAMINATION. Final Report. Mason, D. G.; McCurnin, W. R. (Atomics International, Canoga Park, Calif. (USA)). Jan 1973. 53p. (NASA-CR-121157; AI-73-31). NTIS $4.75.

The SNAP 8 developmental reactor lithium hydride shield was examined after being irradiated for over 7000 hours at relatively low temperature. A crack was located in the seam weld of the containment vessel, probably the result of hot short cracking under thermal stress. The LiH was visually examined at two locations and its appearance was typical of low temperature irradiated LiH. The adherence of the chrome oxide emittance coating was found to be excellent. (auth)

17660 (N-73-24518) THERMOELECTRIC PUMP PERFORMANCE ANALYSIS COMPUTER CODE. SNAP Program. Johnson, J. L. (Atomics International, Canoga Park, Calif. (USA)). 11 Jun 1973. 24p. (NASA-CR-121204; AI-AEC-13095). NTIS $3.25.

A computer program is presented that was used to analyze and design dual-throat electromagnetic dc conduction pumps for the 5-kW(e) ZrH reactor thermoelectric system. In addition to a listing of the code and corresponding identification of symbols, the bases for this analytical model are provided. (auth)

17661 (N-73-24531) DESIGN AND DEVELOPMENT OF LH_2 COOLED ROLLING ELEMENT RADIAL BEARINGS FOR THE NERVA ENGINE TURBOPUMP. Volume 3. Phase 2. Tests on Build-ups 16, 17, and 18 at NRDS, Jackass Flats, Nevada, December 1971-March 1972. Accinelli, J. B.; Koch, D. A.; Reuter, F. (Aerojet Nuclear Systems Co., Azusa, Calif. (USA)). May 1972. 328p. (NASA-CR-132229). NTIS $18.50.

The use of liquid hydrogen to cool the rolling element radial bearings in the nuclear engine for rocket vehicles is discussed. The fifteen hour service life goal was obtained during the tests. The increase in bearing life was also considered to be produced by: (1) improvements in bearing material, (2) bearing retainer configuration and manufacturing changes, and (3) better control of operating parameters. (auth)

17662 (N-73-24664) NERVA 400E THRUST TRAIN DYNAMIC ANALYSIS. Engineering Operations Report. Vronay, D. F. (Aerojet-General Corp., Sacramento, Calif. (USA)). 14 Apr 1973. 192p. NTIS $11.75.

The natural frequencies and dynamic responses of the NERVA 400E engine thrust train were determined for nuclear space operations (NSO), and earth-orbital shuttle (EOS) during launch and boost conditions. For NSO, a mini-tank configuration was analyzed with the forward end of the upper truss assumed fixed at the stage/mini-tank interface. For EOS, both a minitank and an engine only configuration were analyzed for a specific engine assembly support (EAS) stiffness. For all cases the effect of the shield on dynamic response characteristics was determined by performing parallel analyses with and without the shield. Gimbaling loads were not generated as that effort was scheduled after the termination date. The analysis, while demonstrating the adequacy of the engine design, revealed serious deficiencies in the EAS. Responses at the unsupported ends of the engine are excessive. Responses at the nuclear subsystem interface appear acceptable. It is recommended that additional analysis and design effort be expended upon the EAS to ensure that all engine responses stay within reasonable bounds. (auth)

17663 (N-73-24666) NERVA MASS PROPERTIES COMPUTER METHODOLOGY. Engineering Operations Report. Hall, I. K. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 May 1972. 253p. (NASA-CR-132221). NTIS $14.75.

The computer codes are presented that were used for the weight, center of gravity, and mass moment of inertia calculations and documentation for the NERVA. The two programs, E15301 and 12001B, are the basic tools used for weights work on the NERVA program. Used in conjunction with one another, they allow for rapid weights estimates for new concepts or changes while allowing for orderly documentation, which is a necessity in any effective weights effort. Program E15301 requires that each component be resolved into a collection of standard shapes. Separate subroutines than process geometric and material density data for each entry. The master program then performs all calculations necessary to combine these results into a total weight, center of gravity, and moment of inertia for the component. Program 12001B accepts previously calculated weight and center of gravity data for individual components. The program sums weight and calculates center of gravities and moments of inertia for systems of up to four levels of assemblies. The output identifies the engine parts in a format usable directly in a formal report. (auth)

17664 (N-73-24668) COMMON RADIATION ANALYSIS MODEL FOR 75,000 POUND THRUST NERVA ENGINE (1137400E). Warman, E. A.; Lindsey, B. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1972. 174p. (NASA-CR-132228). NTIS $10.75.

The mathematical model and sources of radiation used for the radiation analysis and shielding activities in support of the design of the 1137400E version of the 75,000 lbs thrust NERVA engine are presented. The nuclear subsystem (NSS) and non-nuclear components are discussed. The geometrical model for the NSS is two dimensional as required for the DOT discrete ordinates computer code or for an azimuthally symetrical three dimensional Point Kernel or Monte Carlo code. The geometrical model for the non-nuclear components is three dimensional in the FASTER geometry format. This geometry routine is inherent in the ANSC versions of the QAD and GGG Point Kernel programs and the COHORT Monte Carlo program. Data are included pertaining to a pressure vessel surface radiation source data tape which has been used as

the basis for starting ANSC analyses with the DASH code to bridge into the COHORT Monte Carlo code using the WANL supplied DOT angular flux leakage data. In addition to the model descriptions and sources of radiation, the methods of analyses are briefly described. (auth)

17665 (N-73-24672) VIBRATION COMPUTER PROGRAMS E13101, E13102, E13104, AND E13112 AND APPLICATION TO THE NERVA PROGRAM. Project 187: Methodology Documentation. Engineering Operations Report. Mironenko, G. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1972. 262p. (NASA-CR-132220). NTIS $15.25.

Programs for the analyses of the free or forced, undamped vibrations of one or two elastically-coupled lumped parameter teams are presented. Bearing nonlinearities, casing and rotor distributed mass and elasticity, rotor imbalance, forcing functions, gyroscopic moments, rotary inertia, and shear and flexural deformations are all included in the system dynamics analysis. All bearings have nonlinear load displacement characteristics, the solution is achieved by iteration. Rotor imbalances allowed by such considerations as pilot tolerances and runouts as well as bearing clearances (allowing conical or cylindrical whirl) determine the forcing function magnitudes. The computer programs first obtain a solution wherein the bearings are treated as linear springs of given spring rates. Then, based upon the computed bearing reactions, new spring rates are predicted and another solution of the modified system is made. The iteration is continued until the changes to bearing spring rates and bearing reactions become negligibly small. (auth)

17666 (WANL-TME-1547) STATUS REPORT ON NERVA REACTOR MODEL FOR SYSTEMS ANALYSIS. Lynch, R. M.; Blake, P. J.; Bell, R. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1966. 47p. Dep. NTIS $4.50.

Declassified 31 Aug 1973.

A documentation is presented of the nuclear subsystem equations proposed by WANL for incorporation into the first revision of the NERVA Engine Common Systems Model. A discussion of the proposed model revisions, a listing of the updated model equations, and steady-state and frequency response data obtained with the revised model are presented. The information is sufficient to provide a basis for comparison and validation of alternate computer implementations of the model. 4 references. (auth)

17667 STUDIES AND DEVELOPMENTS ON THE BARRIER OF A PLANT WITH PROTECTION OF THE ENVIRONMENT. Businaro, U. L. (Fiat, Turin). pp 137-172 of Nuclear Energy and the Environment. Rome; Comitato Nazionale Energia Nucleare (1973). (In Italian).

From proceedings of the 17th nuclear congress; Rome, Italy (23 Mar 1972). See CONF-720356-.

The reactor developed for the ship "Enrico Fermi" is a pressurized water type. As a mobile installation it requires special environmental protection features. An attempt is made to illustrate not only the safety aspects common to all types of pressurized water reactors but the particular studies and development in connection with the naval program. The special components developed, such as the instrumentation in the core, reactivity control system, components of the primary circuit, purification system, system for treatment and containment of radioactive wastes, and electrical penetration of the safety container, are described. The principal programs of analysis and experimentation to verify the integrity of the barrier are outlined. (JSR)

17668 FISSIONING URANIUM PLASMAS. Thom, K. (AEC/NASA Space Nuclear Systems Office, Washington, DC); Schneider, R. T. pp 15-38 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

Several concepts for cavity reactors have been proposed in which the nuclear fuel is in the plasma state. Motives for conducting research related to such high-temperature reactors are the possible application of these reactors for high-specific-impulse propulsion in space, magnetohydrodynamic electrical power generation at high efficiency, direct nuclear pumping of lasers, and as a source for process heat. The confinement of the fissioning uranium plasma within the cavity is sought by means of fluid mechanics. The extraction of power is accomplished by radiative transfer. These requirements impose specific problems upon criticality calculations. A significant difference exists between the neutron temperature (thermal) and the uranium plasma temperature. For this reason, more accurate neutron scattering and capture cross-section data in the several-eV-region are needed. Temporal fluctuation of the fuel density and variation of the spatial fuel distribution during operation and start-up require new codes. Reactivity perturbations due to possible uranium influx variations have to be carefully analyzed for power excursions and subsequent disturbances of the balanced system of flow confinement and radiative power transmission. In connection with some of the concepts under consideration, research on nuclear radiation damage of optical transparent material is needed. The US National Aeronautics and Space Administration has conducted an intensive research program on various aspects of fissioning plasmas, analytically and in simulation, particularly regarding the feasibility of two major concepts of cavity reactors. Such work is described. The needs for further research, especially in view of required nuclear data, is discussed. A significant step forward will be the realization of a proposed hybrid research facility consisting of a solid-fuel driver section enclosing the fissioning plasma. This facility would allow basic research on fissioning plasmas. The requirements for codes for design of such a two-component fuel-reactor system are discussed. (32 references) (auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 15566, 15568, 15664, 15922, 15940, and 17578.

17669 (AEC-tr-7502) EXAMINATION GUIDELINES FOR THE SAFETY DESIGN OF LIGHT WATER REACTORS. (Atomic Energy Commission, Tokyo (Japan)). [nd]. Translation of Japanese report. 34p. Dep. NTIS $3.75.

Guidelines to be used for the safety design analysis of light water power reactors as required in the licensing process in Japan are presented. (JWR)

17670 (ANL/ES-25) TEMPERATURE AND VELOCITY MEASUREMENTS AND PREDICTIVE MODEL COMPARISONS IN THE NEAR-FIELD REGION OF SURFACE THERMAL DISCHARGES. Paddock, R. A.; Policastro, A. J.; Frigo, A. A.; Frye, D. E.; Tokar, J. V. (Argonne National Lab., Ill. (USA)). Oct 1973. Contract W-31-109-Eng-38. 170p. Dep. NTIS $7.60.

Simultaneous temperature and velocity measurements were made in the near-field region of the surface thermal discharge at the Point Beach Unit 1 and Palisades Nuclear Power Plants on Lake Michigan. Data collected include measurements of temperature and velocity at the 0.5-, 1.0-, 1.5-, 2.0-, 2.5-, and 3.0-m depths, along with measurements of ambient lake and meteorological conditions. Bottom depth was also measured at various locations. Four such surveys were made at the Point Beach plant, three at the Palisades plant. To examine the jet features from the above surveys and facilitate a comparison with analytical model predictions, a computer program was written to smooth the data, extracting such jet characteristics as trajectory, centerline temperature decay and temperature half-widths, centerline velocity decay and velocity half-widths, temperature and velocity half-depths, and isotherm areas. Four near-field analytical models often used in environmental impact evaluations of power-plant surface discharges are compared to the jet characteristics determined from the smoothed jet data. The Pritchard model compares rather well with these limited data and is often conservative when model-data discrepancies exist. The Stolzenbach-Harleman and Prych models predict too rapid a temperature and velocity decay accompanying too great a lateral spread. The Motz-Benedict model is too sensitive to an entrainment coefficient E with little consistent data available for its determination for accurate prediction. Recommendations for future research, encompassing the field-data acquisition, the smoothing procedure, and the presently available models are included. (30 references) (auth)

17671 (BC-TOP-3(Rev.2)) TORNADO AND EXTREME WIND DESIGN CRITERIA FOR NUCLEAR POWER PLANTS. (Bechtel Power Corp., San Francisco, Calif. (USA)). Dec 1973. 65p.

Nuclear power plant design criteria for tornadoes and extreme winds are presented. Data, formulas, and procedures for determining maximum wind loading on structures and parts of structures are included. Extreme wind loading is applied to structures using methods and procedures consistent with ANSI Building Code A58.1-1972. The design wind velocities specified generally exceed 100-year recurrent interval winds. Tornado wind loading is applied to structures using procedures paralleling those for extrene winds with additional criteria resulting from the atmospheric pressure change accompanying tornadoes and tornado missile impact effects. Tornado loading for the 48 contiguous United States is specified for two major zones separated by the Continental Divide. A cross reference listing items related to Atomic Energy Commission Safety Analysis Report format is provided. Development supporting tornado criteria is included. (auth)

17672 (BNWL-B-327) TENTATIVE RUN MATRIX FOR PFE (PLENUM FILLING EXPERIMENT). Allemann, R. T.; Fryer, B. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 67p.

A tentative run condition matrix for the tests in the Plenum Filling Experiment is described. It discusses some of the scaling factors and the rationale behind the matrix. The trade-offs between geometry, size and flow limitations versus the prototypic values and the desire for overlap in parametric values for different size experiments are discussed. The matrix is tentative because the a priori knowledge of what are the most important parameters is limited. Some tests will begin to show this and suggest changes in the matrix plan. (7 references) (auth)

17673 (FIND-50354) FIND: HOPE CREEK GENERATING STATION, UNITS 1 AND 2. Horn, F. H. (Ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 21p. Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (JWR)

17674 (IAEA-151, pp 513-519) PUBLIC ACCEPTANCE: ENVIRONMENTAL AND OTHER ASPECTS. Sasaki, S. (Tokyo Electric Power Co. Inc., Okuma, Fukushima, Japan). 1972.

In order to obtain public acceptance of a nuclear power plant, information must be made available on those aspects which are of direct concern to the public. They may be summarized as follows: reactor safety, possibility of explosion, reliability of reactor design; radioactive material discharged from the plant and the monitoring system; final radioactive waste disposal; biological effect of radiation, somatic and genetic; thermal effects of discharged cooling water; environmental impact of multiple large-size units at one site, especially with regard to ecology; contributions to the local community. (INIS)

17675 (IAEA-151, pp 521-544) SITE AND SAFETY EVALUATION PROCEDURES IN JAPAN. Sumiya, Y. (Tokyo Electric Power Co. Inc.). 1972.

Site and safety evaluation procedures currently being used in Japan are described. For site evaluation, the characteristics of 8 different Japanese power stations are tabulated. Maps show the Fukushima, Mihama, Takahama, Tsuruga, Onagawa, Hamaoka and Shimane sites. Tables indicate the assumptions used for safety evaluations for reactors (BWR and PWR), for loss of coolant accident, main steam line break accident, and steam generator tube rupture accident. Calculated doses for typical BWR and PWR are given. (INIS)

17676 (INIS-mf-887, pp 4-13) UPSURGE OF NUCLEAR POWER IN THE LIGHT OF THE 4th GENEVA CONFERENCE. Neumann, J. (Ceskoslovenska Komise pro Atomovou Energii, Prague). [nd]. (In Czech).

The reasons are discussed of the recent breakthrough of nuclear power generation and factors are dealt with encouraging its development. Problems are also discussed that still remain to be solved in various fields, such as the environment, nuclear instrumentation, radioanalytical methods, low-activity measurements, waste management, etc. (INIS)

17677 (INIS-mf-887, pp 14-22) RADIOECOLOGY PROBLEMS OF NUCLEAR POWER REACTOR DEVELOPMENT. Klimov, A. G. (International Atomic Energy Agency, Vienna). [nd]. (In Russian).

The current situation is briefly reviewed in view of energy consumption and resources, and the increase in the energy demand in the forthcoming decades is estimated. Possibilities are dealt with of meeting the future energy demand and problems are discussed relating to the development of nuclear power, mainly those affecting the environment. A role is indicated played by IAEA in safeguarding the environment while promoting the development of nuclear power. (INIS)

17678 (INIS-mf-887, pp 33-82) NECESSITY OF SOLVING RADIOECOLOGY PROBLEMS ON NUCLEAR POWER DEVELOPMENT. Zaduban, M. (Univerzita P. J. Safarika, Kosice, Czech.). [nd]. (In Russian).

Current energy requirements and resources are discussed and a prognosis is made of the development of energy balance after 2000. The development is reviewed of nuclear power in the world and individual types of reactors are characterized as well as the availability of nuclear fuel. The contamination is dealt with in more detail of the environment, this both with natural and artificial radioactivity. Attention is focused on the effect of radionuclides on the biosphere. Listed are the tasks that should urgently be fulfilled and the risks that should be prevented. (INIS)

17679 (INIS-mf-887, pp 84-113) RADIOACTIVE ISOTOPE SOURCES AND TRANSPORT PROCESSES IN NUCLEAR POWER PLANTS BEING BUILT IN CZECHOSLOVAKIA. Melichar, Z.; Hladky, E. (Vyzkumny Ustav Energeticky, Jaslovske Bohunice, Czech.). [nd]. (In Czech).

Main factors are discussed affecting the volume and the spectrum of activity released to the environment during the operation and/or accidents of the nuclear power plants of the type considered to be constructed in Czechoslovakia. Technical equipment and methods are reviewed reducing the transport of radionuclides from the primary circuit and thus the radiation risks resulting from nuclear power plant operation to the environment. (INIS)

17680 (INIS-mf-887, pp 266-279) LEGAL ASPECTS OF PEACEFUL USES OF NUCLEAR ENERGY. Elias, J.; Svab, J. [nd]. (In Czech).

Legal aspects of the operation of nuclear power plants are discussed, and a detailed explanation is provided of individual laws and legal norms safeguarding social guarantees and legal security of population in Czechoslovakia in the face of nuclear power plant operation and possible damage resulting from it. (INIS)

17681 (IRS-A-5) EMERGENCY COOLING OF NUCLEAR REACTORS. Heat Transfer Investigations. Andreoni, D. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Cologne (F.R. Germany)). Jul 1973. 68p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

The aim of the research program ERSEC is to obtain experimental results for the calculation of the heat transfer coefficient during emergency flooding in a pressurized water reactor under simulated incident conditions. A brief description is given of the planned test facilities. Furthermore, preliminary results are compiled which have been obtained on a rod with variable parameters as follows: heat flux density 1 to 6 kW/cm^2; mean initial temperature 400 to 900°C; inlet velocity of the cooling water 1 to 20 cm/s; inlet temperature of the cooling water 20 to 90°C; pressure 1 bar; rod heating length 1 m. (GE)

17682 (REG/G-1.64(10-73)) QUALITY ASSURANCE REQUIREMENTS FOR THE DESIGN OF NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Oct 1973. 1p. DRS.

17683 (RT/PROT-(73)15) DESCRIPTION OF THE PROGRAM OF THE FRUSTA CODE. Dini, D.; Lazzeri, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 18 Apr 1973. 67p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.50.

FRUSTA code computes kinematics and loading characteristics of a pipe and related restraints during the LOCA accident. Pipe behavior is assumed to be elasto-plastic. (7 references) (auth)

17684 (UCID-16407) SEISMIC EFFECTS ON A PROPOSED UNDERGROUND REACTOR FACILITY. Tokarz, F. J.; Murray, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Feb 1973. Contract W-7405-eng-48. 12p. Dep. NTIS $3.00.

A study was conducted to determine the seismic effects on the containment structure of a proposed underground reactor facility. Simplified and often inadequate building code equivalent static design procedures frequently used for conventional reactor systems are not adequate for partially buried or fully buried reactor systems. A sophisticated dynamic analysis which can consider soil-structure interaction effects resulting from both seismic displacements and forces must be employed. One such approach would be to use the finite element method. The results of using such an approach to consider both the static overburden and dynamic earthquake effects on the containment structure of the proposed underground reactor facility are presented. (auth)

17685 (WANL-TNR-209) SAFETY ANALYSIS REPORT: EVALUATION OF PASSIVE RE-ENTRY APPROACH. Bridges, J. M.; Brown, W. S.; Call, D. W.; Cleary, J. D.; Hargrove, H. G.; Trammell, M. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1965. Contract SNP-1. 435p. Dep. NTIS $23.75.

Declassified 5 Sep 1973.

An analysis is made to predict the behavior of a nuclear rocket engine in the event of an in-flight failure subsequent to startup of the nuclear stage. The accident model assumes loss-of-coolant to the reactor at time of system failure. It is also assumed that the only direct action taken subsequent to failure is separation of a re-entry vehicle from the remainder of the stage. This vehicle consists of the reactor, pressure vessel, and nozzle. The behavior of the vehicle during its residence time in space and during its re-entry into the Earth's atmosphere is examined and described for three different missions. Two of these are lunar missions employing a NERVA-I class engine, and the third is a Mars fly-by using a NERVA-II class engine. The potential exposure of the Earth's population to nuclear radiation is presented for each of the three missions. (auth)

17686 (WCAP-8204) SAFETY RELATED RESEARCH AND DEVELOPMENT FOR WESTINGHOUSE PRESSURIZED WATER REACTORS PROGRAM SUMMARIES, SPRING–FALL 1973. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 1973. 62p.

Summaries are presented for the following activities: fuel development program for operation at high power densities; in-core detector program; full-length emergency cooling heat transfer system effects tests; reactor vessel thermal shock program; delayed departure from nucleate boiling testing; acoustical monitoring program; steam/water mixing tests; and the process development program for minimizing inpile fuel densification. (JWR)

17687 NUCLEAR ENERGY AND THE ENVIRONMENT. Proceedings of the 17th Nuclear Congress, Rome, Italy, March 23–24, 1972. Serie Simposi. Rome; Comitato Nazionale Energia Nucleare (1973). 344p. (In Several Languages). (CONF-720356-).

Fifteen papers are presented on environmental considerations in the construction and operation of nuclear power plants. A separate abstract was prepared for each of 7 papers. Eight papers were previously abstracted for NSA, and may be found as 27: 9551, 27: 23005, 27: 23006, 27: 24571, 28: 1676, 28: 1677, 28: 1678, and under CONF-720356 in the Report Number Index. (HDR)

For abstracts of individual papers see: 15567, 15922, 17667, 17688–17690, and 17940.

17688 ENVIRONMENTAL PROTECTION AND NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Stauber, E. (AEG-Telefunken, Frankfurt am Main). pp 173-178 of Nuclear Energy and the Environment. Rome; Comitato Nazionale Energia Nucleare (1973).

From proceedings of the 17th nuclear congress; Rome, Italy (23 Mar 1972). See CONF-720356-.

The increase in the number of nuclear power plants being constructed in the Federal Republic of Germany is discussed. An evaluation of reactor accidents and release of radioactive wastes to the environment led to the opinion that the risks are very slight. Principles in the construction of nuclear power plants that serve for protection of the environment are as follows: safe containment, redundancy, minimum activity emission, and analysis of operational faults. (HLW)

17689 RELIABILITY OF NUCLEAR EQUIPMENT AND COMPONENTS. Ferrari, G. (Ansaldo Meccanico-Nucleare SpA, Genoa). pp 179-194 of Nuclear Energy and the Environment. Rome; Comitato Nazionale Energia Nucleare (1973). (In Italian).

From proceedings of the 17th nuclear congress; Rome, Italy (23 May 1972). See CONF-720356-.

The areas in which theoretical reliability studies can be applied practically are indicated. The position of the safety authorities is outlined. Industrial predictions on the use of reliability analysis are summarized. An example is given of the application of reliability analysis to the case of a nuclear turbine for a BWR reactor. (JSR)

17690 ENGINEERING PROBLEMS IN NUCLEAR PLANTS. Mazzoleni, F. (Univ., Naples). pp 207-220 of Nuclear Energy and the Environment. Rome; Comitato Nazionale Energia Nucleare (1973). (In Italian).

From proceedings of the 17th nuclear congress; Rome, Italy (23 Mar 1972). See CONF-720356-.

The technical aspects of the design, construction, testing, and operation of a nuclear plant which can affect the safety and adequate solutions of these problems are briefly summarized. (JSR)

17691 COMMENT ON PRESS REPORTS CONCERNING THE SAFETY OF NUCLEAR POWER PLANTS. Wolf, L. (Technische Univ., Berlin). Energie; 25: No. 10, 277-285(Oct 1973). (In German).

Critical comments are made about two articles published by two opponents of nuclear energy (by Bechert in the "Deutsche Zeitung" of July 27, 1973, and by Hergenroeder in "Konkret", No. 37 (73) p. 22/28 and the conclusion is made that articles of this kind can by no means be regarded as a responsible means of information for the general public. (GE)

17692 ANALYSIS OF METAL–WATER EXPLOSIONS. Board, S. J.; Duffey, R. B.; Farmer, C. L.; Poole, D. H. (Berkeley Nuclear Labs., Eng.). Nucl. Sci. Eng.; 52: No. 4, 433-438(Dec 1973).

The use of equilibrium models for the analysis of metal–water explosions is examined. A theoretical thermal interaction model is then developed that uses the results of basic experiments on transient energy transfer from hot surfaces under water to predict the pressures produced in a metal–water thermal explosion. The model calculates the pressure resulting from energy transfer to a nonequilibrium two-phase coolant expanding in a shock-tube geometry. It is shown that the pressure depends greatly on the distribution of energy between vapor and liquid phase of the coolant and that, in the range of experimentally determined distributions where ~10% of the flux produces evaporation, the pressure is more sensitive to the effective vapor generation rate than to the total flux. Using experimental energy distributions as input data and assuming that the interaction surface area is that determined from analysis of explosion debris, it is shown that the model predicts successfully the peak pressures resulting from two aluminium–water explosions. The results give some confidence that the surface area present at the time of an interaction is of the same order as that of the solidified debris. To predict the results of a thermal interaction in other fluids, however, in addition to the surface-area problem it may be necessary to obtain experimental information about the distribution of energy in the coolant, particularly the effective rate of vapor generation. (auth)

17693 RADIOACTIVE WASTE QUANTITIES PRODUCED BY LIGHT WATER REACTORS. Richardson, J. A. (Burns and Roe Inc., New York). Nucl. Eng. Int.; 19: No. 212, 31-36(Jan 1974).

Statistics for radioactive liquids, gases and solids from operation of light water reactors up to 800 MW(e) are tabulated together with projections for 1100 MW(e) reactors. Handling and transportation procedures for radioactive wastes and spent fuel in compliance with U.S.A.E.C. and Department of Transportation regulations are described. Immobilization methods for radioactive solids for transportation to available land and burial disposal sites in the U. S. are identified. (auth)

17694 LIGHT WATER REACTOR SAFETY. Review of WASH 1250. Rippon, S. E. Nucl. Eng. Int.; 19: No. 212, 25-30(Jan 1974).

A critical review is presented of the report WASH 1250 recently published by the U.S.A.E.C. which deals with the safety of light water cooled nuclear power reactors and related facilities. It was prepared at the request of the Congressional Joint Committee on Atomic Energy to form the basis for in depth hearings on every aspect of light water reactor safety, but the comprehensive nature of the report is likely to make it a valuable source book for nuclear organizations around the world. While the review suggests some shortcomings in the report it is concluded that LWRs are safe. (auth)

Reactor Theory and Calculation

Refer also to abstracts 17105, 17106, 17116, 17301, 17575, 17646, and 17647.

17695 (BNL-tr-551) NUMERICAL METHOD OF SOLVING TWO-DIMENSIONAL AND THREE-DIMENSIONAL DIFFUSION EQUATIONS. Buleev, N. I. Translated by S. J. Amoretty from Mat. Sb.; 51: No. 2, 227-238(1960). 33p. Dep. NTIS $3.75.

A method of solving two-dimensional and three-dimensional elliptic equations is presented which is based on the factorization of the second-order difference equations. The system of first-order difference equations obtained, which is equivalent to the system of the original second-order difference equations, is solved by the successive approximations method. The convergence of the successive approximations is determined by the choice of a certain parameter contained in the problem to be solved. The tests for convergence of the proposed iterative schemes are formulated. The constructed iterative processes are more effective than the ordinary iterative methods of Liebman, Zeidel, and others. The first approximation based on the proposed schemes gives values for the sought-for function that are close to the exact solution of the difference equations. The proposed method makes it possible to solve diffusion equations for space-energy distribution of neutrons in reactors as well as different types of heat and hydrodynamic problems. (auth)

17696 (CONF-730942-P5, pp vp Paper L 1/3) CONJUGATE HEAT TRANSFER PROBLEMS WITH NUCLEAR HEATING. Chen, P. Y. P.; Thompson, J. J. (Univ. of New South Wales, Kensington, Australia). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The exact thermal analysis of a slender canned rod with an arbitrary internal nuclear power distribution under axial forced convection turbulent flow of a constant property coolant is treated. Three-dimensional heat conduction in the solid component is permitted, so that exact surface temperatures and heat fluxes, coolant temperature profiles and consistent internal solid temperature fields for thermoelasticity analysis can be calculated, with full allowance for end conditions. The necessity to define heat transfer coefficients a priori is avoided, and the correct spatially variable heat transfer coefficients result from the analysis. A general

formulation is developed for fully developed turbulent flow, uniform inlet temperature, constant rod conductivity and insulated end boundary conditions. Fourier series expansion in the azimuthal direction decouples the angular harmonics, and each resulting coupled two-dimensional conjugate problem for the harmonics becomes amenable to the same type of analysis. Separate general Green's function solutions for the solid and fluid regions, expressible in terms of the eigenfunctions generated by the relevant linear operators and homogeneous boundary conditions, are used to express the individual surface heat fluxes in terms of the common surface temperature. Equating heat fluxes leads to a single integral equation for the surface temperature distribution. A Fourier cosine series expansion of surface temperature and a weighted residual approximation reduce the integral equation to a set of simultaneous linear equations in the Fourier coefficients for each harmonic. The method is illustrated by application to a simple heat generating plate problem, using published numerical data for the fluid eigenvalues and eigenfunctions. The formulation is extended to include a temperature dependent plate conductivity, characteristic of nuclear fuel, by utilizing the fact that only the surface temperature is involved, and hence the surface conductivity admits a simple two parameter representation. An efficient iterative technique is developed for computation, and numerical results displayed. (auth)

17697 (FEI-387) CALCULATION OF MULTIDIMENSIONAL HYDROGENOUS REACTORS IN A MULTIGROUP p_1 APPROXIMATION. Bel'skaya, Zh. N.; Mironovich, Yu. N.; Nikolaishvili, Sh. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 25p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The derivation of the diffusion difference equations and their reduction to a form suitable for programming are described. The numerical algorithm, developed suitably for the calculation of hydrogenous reactors, is described. The structure and the basic characteristics of the program DD, representing the proposed algorithm in the ALGOL language for the TA-2 translator, are explained. (tr-auth)

17698 (FEI-392) CALCULATION OF THE EFFECTS OF SELF-SHIELDING DURING MEASUREMENT OF REACTIVITY COEFFICIENTS. Dulin, V. A.; Mamontov, V. F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The procedures for the calculation of the effects of self-shielding of samples during the measurement of the reactivity coefficients were described. The procedures for the calculation of the self-shielding for absorbing, fissionable, and scattering materials were examined. The attenuation of the group current in the samples was calculated in the Wigner approximation with allowance for the resonance absorption. The results of the calculation of the dependence of the reactivity coefficient of U, Pu, Au, Ta, B, graphite, and hydrogen on the dimensions of the sample were reported. The calculations were compared with experimental results. (tr-auth)

17699 (IAE-2250) NEW METHOD FOR THE CALCULATION OF HETEROGENEOUS REACTORS. Gorodkov, S. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

A new method called a quasi-albedo method is described which rewrites the two-dimensional diffusion equations with line sources-sinks in a form similar to the finite-difference one. For this purpose the reactor is covered with the square grid of mesh lines with the spacing equal to the lattice pitch so that the line source-sinks can be only in its mesh points. The neutron distribution in each grid cell can be constructed with high precision from the elementary distributions of only two types. The condition of maximum smoothness of the neutron field, obtained in such a way leads to the equations connecting the external fields in the mesh points so that each point interacts directly only with eight nearby points. The preliminary calculations showed good accuracy of the new method. (6 references) (auth)

17700 (IAE-2295) TWO-GROUP CALCULATION OF THE HETEROGENEOUS REACTOR BY THE QUASI-ALBEDO METHOD. Gorodkov, S. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The method called the quasi-albedo method gives the Feinberg-Galanin two-group equations in the form similar to the finite-difference one. As a result of this the computing time taken to iterative solution of these equations is reduced by 15 to 20 times compared to the conventional heterogeneous method. Two-group two-dimensional calculation of the assembly with the number of rods of about 1900 and the flux accuracy no lower than 1% requires less than 3 min on the BESM-6 computer. (auth)

17701 (N-73-26722) CATALOG OF EXPERIMENTAL PROJECTS FOR A FISSIONING PLASMA REACTOR. Lanzo, C. D. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jun 1973. 27p. (NASA-TM-X-68232; E-7444). NTIS $3.50.

Experimental and theoretical investigations were carried out to determine the feasibility of using a small scale fissioning uranium plasma as the power source in a driver reactor. The driver system is a light water cooled and moderated reactor of the MTR type. The eight experiments and proposed configurations for the reactor are outlined. (STAR)

17702 (SRARI-P-191) NATURAL CIRCULATION IN PARALLEL CHANNEL SYSTEMS OF NUCLEAR POWER PLANTS. Markin, S. A.; Aleksandrov, K. A.; Krasnoyarov, N. V. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 32p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

The development of the equations describing the steady circulation in parallel channels for a nuclear power plant with a single-phase coolant is traced. The conditions of the natural circulation reversal for the coolant flowing upward and downward in the reactor were treated. The evaluation of the stability for certain operating conditions is also given. (auth)

17703 (STI/PUB-343(Vol.1)) NUCLEAR DATA IN SCIENCE AND TECHNOLOGY. Volume I. Proceedings Series. Proceedings of the Symposium Held in Paris, France, March 12–16, 1973. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. 630p. (In Several Languages). (CONF-730302-(Vol.1)). IAEA $26.00.

Information concerning the use of nuclear data is presented under the following main headings: future technology requirements; reactor technology; safeguards; life sciences; radioisotopes in chemistry; fission product nuclear data; and accelerator and space shielding. Separate abstracts are included for 30 of the 33 papers presented. Three of the papers have been previously abstracted and included in NSA under the following abstract numbers: 27: 23718; 28: 00087; and 28: 23686. (DCC)

For abstracts of individual papers see: 15256, 15321, 15408, 15428, 15429, 15442, 15776, 15973, 16111, 16112, 16388, 16405, 16420, 16421, 17101–17103, 17248, 17249, 17306–17309, 17471, 17472, 17668, and 17709–17712.

17704 EQUIVALENCE RELATIONS FOR RESONANCE INTEGRAL CALCULATIONS. Stamm'ler, R. J. J.; Blomstrand, J.; Weiss, Z. J. (ASEA-ATOM AB, Vaesteraas, Sweden). J. Nucl. Energy; 27: No. 12, 885-888(Dec 1973).

An approximate model is presented for evaluating the fuel collision probability of an array of identical pins in terms of single rod probability and two fuel-independent quantities, one of which describes the effect of lattice irregularities. The resulting equation is similar to the one in current use but is more rigorous and does not involve assumptions concerning any region other than that of the fuel. (UK)

17705 NON-ITERATIVE METHOD OF SOLVING CONJUGATE EQUATIONS FOR A CRITICAL REACTOR. Kochurov, G. P. At. Energ. (USSR); 35: No. 1, 52-54(Jul 1973). (In Russian).

With numerical realization of optimized algorithms of the iterative type, significant expenditures of machine time at each step of the iteration occur in the search for conjugate functions, whose number and type of problem limitations and which may run in the tens. The solution can be found in one step with a scan by the use of a matrix factorization. The differential expression of the G-group diffisuion problem with a finite difference representation for a fixed number of zones of division in a reactor is solved and programmed to carry out the calculations. (SJR)

17706 COMPARISON BETWEEN NEUTRON WAVES REFLECTED FROM THE REFLECTOR AND FROM THE CORE OF A WATER-MODERATED AND -REFLECTED REACTOR. Shani, G. (Univ. of the Negev, Beer-Sheva, Israel). Nucl. Sci. Eng.; 52: No. 4, 439-446(Dec 1973).

When a propagating neutron wave reaches an interface between two media, a part of it is transmitted and a part is reflected. In the present work, neutron waves reflected from the core and from the reflector are compared. The following is concluded: reflection exists in both cases. When the first medium in which the wave is propagating is a multiplying medium, it is much easier to detect the reflected wave than it is in the nonmultiplying diffusive medium. The reflected wave amplitude and phase depend much more on the properties of the first medium than on the properties of the reflecting medium. Neutron waves reflected back into the core are in phase with the propagating waves and hence reinforce them. Neutron waves reflected by the core are out of

phase with the propagating waves and hence weaken them. Other characeristics of the amplitudes and phases of waves in both cases are compared. (auth)

17707 MULTIGROUP EIGENFUNCTION EXPANSION TECHNIQUE FOR SELECTING POISON DISTRIBUTIONS FOR OPTIMUM REACTOR POWER DISTRIBUTIONS. Long, S. M. Gainesville, FL; Univ. of Florida (1972). 166p. University Microfilms Order No. 73-29,190.

Thesis (Ph. D.).

The capabilities of an eigenfunction expansion technique were explored to aid in the selection of a poison distribution that will produce the optimum power distribution in a reactor. A method is introduced which is useful in the repeated evaluation of power distributions resulting from various poison distributions as they are selected for investigation by a numerical optimization routine. This method is based on multigroup diffusion theory, and employs the finite difference approximations to the spatial dimensions. First, the eigenfunction expansion problem is reviewed in one-group theory. Then, the multigroup problem is outlined and the arbitrariness of the flux-power relationship in this formulism is discussed. The actual unknowns for the optimization problem (using a preselected poison material) are pointed out to be the poison concentrations and the flux spectral relationships. The inherent nonlinearity of the problem is discussed for the case where these unknowns are treated directly as variables. The orthogonality and completeness properties of various sets of eigenvectors are discussed regarding the poison optimization problem. These sets include the natural modes, the fission modes, the time-space separable kinetic modes, the thermal poison modes and the multigroup poison modes. The multigroup poison eigenvectors are chosen for use in the expansion technique. A Wielandt transformation method for generating this set of eigenvectors is explained, and a computer program, demonstrating the technique, is listed as an appendix. The poison eigenvectors for several two-group, multiregion reactors are presented. The necessity for solution of the optimum multigroup poison distribution problem by numerical search is discussed in general. The poison eigenvalue formulation of the criticality equation is introduced, and its advantages and weaknesses, as compared to the usual reactivity eigenvalue formulation, are discussed. Two methods are suggested for overcoming the weaknesses. One, a Wielandt transformation method, is conceptually straight forward, but computationally clumsy. The second, a transformation of the set of eigenvalues of the poison eigenvectors, is potentially a better computational device, but is conceptually much more complex. Only the first method is programmed and demonstrated by numerical example. Sample two-group, one-dimensional optimization searches, using the Gaussian least squared error method, are presented for several examples in order to demonstrate the techniques and phenomena that have been discussed. The results are checked for accuracy with a standard multigroup diffusion theory code. These calculations are then extended to explore the possibility of using incomplete sets of poison eigenvectors for expansion. The results of partial expansions in both underspecified and completely specified optimizations are discussed. Considerable accuracy of partial expansions is shown in the limited class of examples considered (thermal reactors). The potential utility of the method is presented and suggestions are made for future work directed at ultimately incorporating the techniques in a standardized computer code for use as an engineering tool. (Diss. Abstr. Int., B)

17708 CALCULATIONS OF FAST-REACTOR DATA-TESTING ASSEMBLIES UTILIZING CROSS SECTIONS FROM THE MC^2 AND SDX CODES. Pennington, E. M. (Argonne National Lab., IL). Nucl. Sci. Eng.; 52: No. 4, 486-492(Dec 1973).

Reactor physics calculations were performed with ENDF/B Version-III cross-section data for several of the fast-reactor data-testing assemblies specified by the Cross Section Evaluation Working Group. In these calculations, multigroup cross sections were generated using both the Argonne MC^2 and SDX codes for comparative purposes. The multigroup cross sections were then used in S_n transport-theory calculations to obtain k_{eff} and central activation ratios, and in perturbation-theory calculations to obtain central worths. Results with MC^2 and SDX cross sections are in good agrement except whem regions containing large amounts of a structure material are involved. (auth)

17709 ACCURACY OF NUCLEAR DATA AND ITS EFFECT ON FAST-REACTOR DESIGN. An approach to Setting up Nuclear Data Accuracy Requirements. Usachev, L. N.; Manokhin, V. N.; Bobkov, Yu. G. (Physical Power Inst., Obninsk, USSR). pp 129-142 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

The prediction of fast-reactor parameters is discussed concerning the accuracy required in obtaining them from neutron calculations and concerning error magnitudes. A method of determining the errors of various quantities resulting in a given value of a reactor parameter is described. The accuracy of nuclear data resulting in an error of ±2% in the conversion ratio is discussed; the use of integral experiments in relaxing the accuracy requirements for microscopic data is studied. (24 references) (auth)

17710 RESPECTIVE ROLES OF EVALUATIONS AND INTEGRAL EXPERIMENTS IN THE PHYSICS OF FAST REACTORS. Barre, J. Y.; Chaudat, J. P. (CEN, Cadarache, France). pp 143-154 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

Applications of nuclear data to the prediction of fast-power reactor parameters are described. In the integral approach chosen at the Commissariat à l'énergie atomique, differential measurements play, through evaluations, a complementary role with respect to the critical experiments which serve as references. The significance of differential measurements in realizing version 3 of the Cadarache multigroup effective cross-section sets and the most important future needs of the fast-reactor physicists are described. (14 references) (auth)

17711 CROSS-SECTION UNCERTAINTY EFFECTS ON THE RATIO OF THE HIGH-ENERGY NEUTRON FLUX TO THE POWER AND RESULTING ESTIMATION OF THE IRRADIATION LIMIT ERRORS IN A FAST POWER REACTOR. Boili, A. (Progettazioni Meccaniche Nucleari, Genoa); Cecchini, G. P.; Cosimi, M.; Salvatores, M. pp 155-162 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

The results of some relevant cross-section uncertainty effects on the ratio φ_H/P of the high-energy neutron flux to the specific power produced in different zones of a fast power reactor are presented. In particular, the uncertainty effects of ^{238}U fission, capture and high-energy inelastic scattering cross-sections, prompt neutron spectrum, high-energy ^{239}Pu fission cross-sections, etc. are considered. The calculations are performed by two-dimensional generalized perturbation methods. The structural material swelling is essentially determined by the ratio considered, φ_H/P, as a function of the total energy produced in the reactor. Therefore, the related irradiation limits can be investigated in terms of cross-section uncertainties. The results are discussed, allowing for the different correlations which can be used in the swelling calculations. (19 references) (auth)

17712 ASSESSMENT OF METHODS AND DATA FOR PREDICTING INTEGRAL PROPERTIES FOR URANIUM-FUELLED THERMAL-REACTOR PHYSICS EXPERIMENTS. Chawla, R. (Indian Inst. of Tech., Kanpur). pp 175-188 of Nuclear Data in Science and Technology. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 1); CONF-730302-(Vol. 1).

The performance of "best" available theoretical methods and differential nuclear data for predicting integral thermal-reactor properties, such as reactivity and reaction rate ratios, is assessed in the light of evidence from a broad range of clean, benchmark experiments. It is shown in the present study that for improving the consistency of calculated integral parameters for D_2O, H_2O and graphite moderated systems, significant modifications to certain currently used nuclear data are desirable. Along with changes in moderator scattering cross-sections, ^{238}U resonance data and the ^{235}U fission energy spectrum, some modification of ^{235}U thermal data has been made which lies within the experimental uncertainties of differential measurements. The "new" data options have been used in various analyses with the WIMS lattice code, and results are presented for the benchmark studies and also for some lattices with more complicated geometries. It is shown that the preferred data generally give more consistent results, for both reactivities and reaction rates over a wide range of conditions, than any previously considered data combinations. (32 references) (auth)

17713 USE OF NUCLEAR DATA IN THE MONTE-CARLO CODES GEM AND MONK IN REACTOR PHYSICS AND CRITICALITY CALCULATIONS. Moore, J. G. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). pp 121-134 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 2); CONF-730302-(Vol. 2).

A description is given of the nuclear data used in the Monte-Carlo codes GEM and MONK, and its use in reactor physics and criticality calculations. The nuclear data are based on the UK Nuclear Data Library and because of the importance of the total cross section in the calculation, no approximations are made to the original library data. The representation of the total cross-section, therefore, is in the form of a table of point values at specific energies, unlike most codes which have group representation. Group constants however are used for the relative probabilities of the partial cross sections. There are two main approximations in the use of nuclear data in GEM and MONK: there is a single energy group below 0.1 eV and unresolved resonances are not considered. Calculations on critical systems have shown that the multiplication factor, k, usually lies within about 5 per cent of unity. It is possible that this spread in the multiplication factor could be due to these approximations. Calculation of reaction rates in low-power reactors has shown agreement within about 10 per cent of experimental results. It is concluded that, in spite of the approximations in the nuclear data, the use of the UK Nuclear Data Library gives reasonable agreement with experiment. It is recommended at present, however, that sufficiently large safety factors should be incorporated in the predictions of critical mass until the nature of the discrepancies is understood. Future work is aimed at removing the approximations in the nuclear data. (auth)

17714 WATER-MODERATED REACTOR ANALYSIS WITH ENDF/B DATA. Jabbawy, S.; Karni, J.; Rothenstein, W.; Velner, S. (Technion–Israel Inst. of Tech., Haifa). pp 147-186 of Nuclear Data in Science and Technology. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973). See STI/PUB-343(Vol. 2); CONF-730302-(Vol. 2).

The clean thermal-reactor lattices with heavy and light water as moderator, originally studied by Honeck, Hellens et al., have been re-analyzed with recent versions of ENDF/B data. A study based on the first ENDF/B compilation using the HAMMER code system at Brookhaven National Laboratory led to eigenvalues which were by one to two per cent too low. The later data sets, which necessitated modification of the multigroup library preparation code to handle the new formats and improved information, have not changed the results significantly. Attempts have been made to determine which part or parts of the analysis might account for the discrepancies which have been found. A number of parameters have been compared with Monte-Carlo calculations which made use of the same basic data. Of these comparisons, the ones relating to the resonance and thermal reaction rates have been described previously. The values of the effective resonance integrals, as obtained by the Nordheim method in the HAMMER code, were decreased in accordance with the results then obtained. The THERMOS integral transport treatment of the unit lattice cell at thermal energies and subsequent Fourier-Transform leakage-spectrum calculations have been left unchanged. The Monte-Carlo estimates, treating the scattering anisotropy more fully, had resulted in very similar thermal reaction rates and slightly reduced leakage; for D_2O-lattices, the resulting increase in k_{eff} was not more than 0.2 to 0.4 per cent, and for H_2O lattices, the eigenvalues were changed even less. Scattering anisotropy as specified in the ENDF/B data, together with the basic recommended cross-sections, have now also been included in a Monte-Carlo code for the epithermal energy region. The code has been used to verify the accuracy of the HAMMER code in which cell homogenization is effected by means of standard collision-probability methods, and the leakage spectrum is obtained by the MUFT B-1 procedure. At high energies, where the anisotropy of scattering becomes more important, the Monte-Carlo estimates led to a somewhat softer spectrum for the H_2O-moderated lattices. The leakage rates as obtained by the two methods are in reasonable agreement. It may be concluded that the accuracy of rapid evaluations of the effective lattice resonance integrals from the basic ENDF/B data is the main cause of error in the lattice analysis. (auth)

17715 THERMOGENE, AN INTEGRAL TRANSPORT PROGRAM FOR ARBITRARY X–Y GEOMETRY SYSTEMS. III. Calculation of Actual Light Water Reactor Lattices. Janssen, A. J.; Brand, P.; Caspers, L. M. (Interuniversitair Reactor Instituut, Delft, Netherlands). Atomkernenergie; 22: No. 1, 14-23(Sep 1973).

Thermal neutron spectra, fluxes and fission densities in typical PWR and BWR fuel assemblies are presented as a demonstration of the 2-d program THERMOGENE. Calculated results are given for standard uranium assemblies, controlled and uncontrolled, for assemblies containing burnable poison pins and for a BWR assembly containing a plutonium "island". A comparison with diffusion theory calculations shows that this theory is adequate for fairly regular assemblies, but that, on the whole, it cannot treat local perturbations with sufficient accuracy. A description of THERMOGENE was given in Part I. The experimental verification of calculated results was presented in Part II. (GE)

Reactor Components and Accessories

Refer also to abstracts 15502, 15510, 15512–15514, 15516, 15518–15520, 15523–15525, 15528, 15529, 15532, 15702, 15703, 16211, 16212, 16240–16248, and 16355.

17716 (IAEA-145, pp 501-505) OPERATION SURVEILLANCE OF NUCLEAR POWER PLANT COMPONENTS BY VIBRATION AND NOISE ANALYSIS. Ehrentreich, J. W. (Commission of the European Communities, Brussels). 1972.

From meeting on NDT for reactor core components and pressure vessels; Vienna, Austria (29 Nov 1971).

Damage occurred to coolant recirculating pumps and to reactor internals in pressurized-water reactor plants which led to long shutdown periods and enormously complicated and costly repairs to activated components. Nineteen instances of damage to turbines in Community nuclear power plants have been reported since 1963 which likewise involved long outages. Continuous surveillance of these components could probably have facilitated the early detection of changes likely to cause damage, provided that suitable techniques had been available, thus cutting down outages and repairs. It is in the plant operators' interest to develop methods and instruments for the continuous operational surveillance of the vibration characteristics of important nuclear power plant components and to demonstrate their effectiveness. A study contract to critically compare operational surveillance techniques for components of nuclear power plants by vibration and noise analysis for the early detection of damage and theoretical studies for their further development was begun. (auth)

17717 (RDT-E-3-12-T(8-73)) RADIOACTIVE GAS COMPRESSORS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Aug 1973. 25p. RSO.

The design, construction, and performance requirements for radioactive gas compressors are presented. (DCC)

17718 (RDT-M-7-14-T(1-74)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY ROD (ASME SB-336 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Jan 1974. 7p. RSO.

Manufacturing requirements for nickel–molybdenum–chromium alloy rods for corrosion and heat resistant service in nuclear applications are presented. (DCC)

17719 SPACER GRIDS FOR CELLULAR NUCLEAR REACTOR FUEL ELEMENT SUBASSEMBLIES. Chetter, J. (to United Kingdom Atomic Energy Authority). German Patent 2,233,051. 25 Jan 1973. 13p. (In German).

The spacer grid acts as spring-flexible surrounding for the fuel pins in the grid cells by means of bent spring localization components. The fuel pins are held against opposite-lying supports by these springs. The arrangement of the bent spring localization components is important. (GE)

17720 THERMAL INSULATION. Denis, R. (to EURATOM). Luxemburgian Patent 62,627. 18 Feb 1971. (In German).

Available from the Commission of European Communities, Luxembourg.

In nuclear reactors with concrete vessels the thermal insulation between the hot core and the concrete needs particular attention. The insulation should be compact, flexible, reliable, economic and capable of withstanding high temperatures (above 500°C). It consists of several superimposed chambers which are delimited by metallic foils and filled with metallic meshwork of extremely high porosity. The meshwork is made by superimposing several layers of knitted wires, the layers comprising a wave structure perpendicular to the layer surface. In adjacent layers the directions of the wave intersect. This material is commonly used to fill air filters. Pressure equalization between the chambers is achieved via the edges of mattresses into which the entire surface is subdivided in order to facilitate prefabrication. The mattresses are fixed to the wall by means of hollow bolts. (EU)

17721 STEAM GENERATOR CRADLE SUPPORT. Marroni, M. A. Jr.; Peck, D. A. (to Combustion Engineering Inc.). US Patent 3,771,499. 13 Nov 1973. Filed date 20 Dec 1971. 6p.

Means for laterally supporting a nuclear steam generator against the effect of seismic loadings or other shock loadings imparted by external or internal causes are disclosed. Support is provided by means of a stiffening structure incorporating a shock suppressor

apparatus which operates through the lever arm of a mechanical linkage. The apparatus is designed to permit unrestrained lateral movements caused by thermal growth of the equipment, but undesired lateral loadings, such as those caused by earth tremors or equipment failure, automatically render the apparatus operative to support the steam generator against these loadings. (Official Gazette)

17722 GRIPPING DEVICE FOR ROD-SHAPED PARTS OF A NUCLEAR REACTOR. Mohm, F. (to INTERATOM). German Patent 1,781,449. 26 Apr 1973. 1p. (In German).

The gripping device is suitable for rod-shaped components (fuel, moderator, absorber rods) which can be displaced in a longitudinal direction. It is coupled to a shaft-sliding mechanism and consists of a combination of components, which can be opened and closed by driving clamps out and in. (GE)

17723 HEAT EXCHANGERS FOR SODIUM-COOLED NUCLEAR REACTORS. Keusenhoff, J. (to INTERATOM). German Patent 2,046,548. 15 Feb 1973. 3p. (In German).

Heat exchangers operating with liquid sodium (primary medium) and water/steam (secondary medium) are described. The media are separated from one another by a several layer pipe. The construction and assembly of this pipe is described to which a leak detector chamber is attached. (GE)

17724 REACTOR VESSEL INSPECTION DEVICE. Wiesener, R. W. (to Programmed and Remote Systems Corp.). US Patent 3,780,571. 25 Dec 1973. Filed Date 22 Apr 1971. 16p.

A device is described for in-place inspecting nuclear reactor pressure vessels and which can be removed from the vessel when the vessel is in-service. The device can be utilized to inspect the vessel during routine maintenance. The device is mounted so that its position and movements can be repeated on subsequent inspections, and by proper recording of data from initial inspections, defects, cracks, or other hazardous situations can be discovered. (Official Gazette)

17725 NUCLEAR REACTOR BOILER SYSTEM. Charcharos, A. N. (to British Nuclear Design and Construction Ltd.). US Patent 3,775,248. 27 Nov 1973. Priority date 25 Feb 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

In a nuclear reactor in which coolant flow through the reactor core is downward, the boiler system to which the heated coolant is fed is arranged so that, although the coolant flow through the boiler system is generally upward, it is nevertheless downward in those parts of the boiler system which contain water in the liquid phase; and the flow of water through those parts is arranged to be upward, thereby alleviating the problems of instability and thermal shock which are associated with downward water flow particularly at low flow rates. (Official Gazette)

17726 FORMAL METHODOLOGY FOR FAULT TREE CONSTRUCTION. Fussell, J. B. (Georgia Inst. of Tech., Atlanta). Nucl. Sci. Eng.; 52: No. 4, 421-432(Dec 1973).

A model is presented for formulating the Boolean failure logic, called the fault tree, for electrical systems from associated schematic diagrams and system-independent component information. The model is developed in detail for electrical systems, while its implication and terminology extend to all fault tree construction. The methodology is verified as formal by fault trees constructed by a computer with typical execution times for a fault tree with 100 gates on the order of 7 sec (on the UNIVAC 1108 computer). The model, called Synthetic Tree Model, is a synthesis technique for piecing together, with proper editing, a fault tree from system-independent component information beginning with the main failure of interest and proceeding to more basic failures. The resultant fault trees are in conventional format, use conventional symbols, and are, consequently, immediately compatible with existing solutions techniques. While Synthetic Tree Model develops the fault tree to the level of primary failures, extensions of the model could handle secondary failures, i.e., failure-related feedback between components. (auth)

Reactor Fuels

Refer also to abstracts 15517, 15521, 15522, 15526, 15531, 16122, 16123, 16126–16129, 16135, 16136, 16141, 16142, 16152, 16164, 16169, 16215, 16230, 16238, 16366, 16449, and 17605.

17727 SPACER GRIDS FOR FUEL RODS OF NUCLEAR REACTORS. Werner, L.; Ricken, E. (to INTERATOM). German Patent 2,145,509. 15 Mar 1973. 7p. (In German).

A cellular spacer grid with a regular hexagonal grid is described. The 6 grids of a cell are either constructed alternately concave and convex with regard to the fuel rod standing in this cell, or have the form of at least 2 lines at opposite angles to each other. The grid is made by means of the spark erosion method. (GE)

17728 SPACER GRIDS FOR FUEL ELEMENT SUBASSEMBLIES OF NUCLEAR REACTORS. Leaver, B.; Seddon, T. (to United Kingdom Atomic Energy Authority). German Patent 2,233,048. 25 Jan 1973. 9p. (In German).

A rigid lattice construction made of criss-cross components is described which form cells, each of which is penetrated by a fuel pin of the construction group. Spring flexible component strips form a cross holder. (GE)

17729 SPACER GRIDS FOR NUCLEAR FUEL ELEMENT SUBASSEMBLIES. Leaver, B.; Mercer, W. (to United Kingdom Atomic Energy Authority). German Patent 2,233,050. 25 Jan 1973. 9p. (In German).

A description is given of a spacer grid made of strip components fitted into each other in toothlike fashion forming cells for elongated fuel pins which are held in a bundle by axes running parallel to one another. (GE)

17730 SPACER GRIDS FOR CELLULAR NUCLEAR REACTOR FUEL ELEMENT SUBASSEMBLIES. Chetter, J. (to United Kingdom Atomic Energy Authority). German Patent 2,233,049. 25 Jan 1973. 21p. (In German).

A description is given of a spacer grid made of strip components fitted into one another in toothlike fashion forming cells which are penetrated by fuel pins resting against rigid supports. The bent springs are connected one beneath the other to a step-spring component group. (GE)

17731 FUEL ROD SPACERS IN NUCLEAR REACTOR FUEL ELEMENTS. Biermann, W.; Lohe, J. (to INTERATOM). German Patent 1,951,179. 26 Apr 1973. 3p. (In German).

A spacer consisting of a system of spring and spacer bands is described which is fitted on crossed, comblike coupled wet plates. (GE)

17732 SPACER GRIDS AS MOUNTING SUPPORT FOR NUCLEAR FUEL RODS. Jabsen, F. S. (to Babcock and Wilcox Co.). German Patent 1,956,053. 29 Mar 1973. 5p. (In German).

The spacer grid consists of rigid metal strips which fit into one another in a tooth-like manner and have elastic sectors. At least one wall of each cell formed, has an elastic sector which can be deflected in order to allow the fuel rod into the cell. The discovery described these sectors, their design and coordination. (GE)

17733 BURNUP MEASUREMENT. Oshima, K. (Tokyo (Univ.); Natsume, H.; Okashita, H.; Umezava, H.; Komori, T. Nippon Genshiryoku Gakkaishi; 15: No. 6, 361-385(Jun 1973). (In Japanese).

Some subjects related to burnup measurement are reviewed from 1960 to 1973. Relation was adopted in ASTM in the case where the fuels contain only U or up to 50% of Pu. Specific burnup (MWD/MTU) = Burnup (%) $\times$ 9.6 $\pm$ 0.3 $\times$ 10^3; where burnup was defined as the rate of total fission numbers to the numbers of heavy elements (N > 232) before irradiation. The objects of the burnup measurement are the advancement of the power reactor economy, the testing of irradiated fuels and the fuel management. The burnup measurement is divided into the destructive and the nondestructive method. The former contains FP monitoring and the heavy element isotope ratio method, and the latter consists of passive methods (calorimetry, γ spectroscopy and coincidence method) and active methods (neutron transmission, photonuclear reaction, neutron interrogation, and equivalent reactivity method). These methods and related problems are outlined, and hot lab works are described. The burnup calculations are made on every stage of the reactor design. The burnup code is divided into the prospective calculation, the correction calculation and the record processing part from viewpoint of their functions. Present and future status are discussed of the lattice burnup and the core burnup calculation in the LWPR, the HWPR and the graphite moderated gas cooled power reactor. Recently, new procedures of nuclear material management and safeguards, such as burnup measurement and related isotope correlation, have been developed. (JA)

Reactor Control Systems

Refer also to abstracts 16187 and 17598.

17734 (HW-57018) REACTOR SAFETY CIRCUITS. 105-N Design Criteria. Project CAI-816. Strong, G. H. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 15 Sep 1959. 26p. Dep. NTIS $3.50.

Declassified 4 Apr 1973.

The design of the 105-N reactor safety circuits is described. The safety circuits include normal rod control, power setback, fast rod scram, ball safety system, and semi-automatic rod control. (JWR)

17735 (IAEA-147, pp 99-102) CERTAIN ENGINEERING PROBLEMS IN THE THAI RESEARCH REACTOR. Pumlek, R. (Office of Atomic Energy for Peace, Bangkok). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Temporary means were performed to put the reactor back into operation when the critical components were defective. The real problem was spare parts shortage because the original supplier was no longer in the reactor business. A brief description of the replacement of the Curtiss-Wright designed shim-safety rods and reactor magnets with solid boron stainless steel rods and RMG type magnets respectively is given. (auth)

17736 (IAEA-147, pp 103-108) BORON-STAINLESS STEEL SHIM-SAFETY RODS AND THEIR WORTHS IN "TRR-1" CORE AS COMPARED TO THE B_4C-FILLED RODS. Kasemsanta, S. P. (Office of Atomic Energy for Peace, Bangkok). 1972.

From meeting on research reactor utilization; Bandung, Indonesia (2 Aug 1971).

Swelling of the B_4C-filled shim safety rods originally supplied by Curtiss Wright for the TRR-1 reactor is discussed. The approach taken to replace these safety rods by rods of a superior design and the experiments to determine the rod worths of the new shim-rods are described. (4 references) (auth)

17737 (N-73-22429) PRELIMINARY DESIGN OF BEARINGS FOR THE CONTROL SYSTEM OF A HIGH-TEMPERATURE LITHIUM-COOLED NUCLEAR REACTOR. Yacobucci, H. G.; Waldron, W. D.; Walowit, J. A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1973. 68p. (NASA-TM-X-68218). NTIS $5.50.

The design of bearings for the control system of a fast reactor concept is presented. The bearings are required to operate at temperatures up to 2200°F in one of two fluids, lithium or argon. Basic bearing types are the same regardless of the fluid. Crowned cylindrical journals were selected for radially loaded bearings and modified spherical bearings were selected for bearings under combined thrust and radial loads. Graphite and aluminum oxide are the materials selected for the argon atmosphere bearings while cermet compositions (carbides or nitrides bonded with refractory metals) were selected for the lithium lubricated bearings. Mounting of components is by shrink fit or by axial clamping utilizing differential thermal expansion. (auth)

17738 ELECTRIC POWER PLANT SYSTEM AND METHOD FOR OPERATING A STEAM TURBINE ESPECIALLY OF THE NUCLEAR TYPE WITH ELECTRONIC REHEAT CONTROL OF A CYCLE STEAM REHEATER. Luongo, M. C. (to Westinghouse Electric Corp.). US Patent 3,782,113. 1 Jan 1974. Filed Date 27 Jan 1972. 24p.

An electronic system is provided for operating a nuclear electric power plant with electronic steam reheating control applied to the nuclear turbine system in response to low pressure turbine temperatures, and the control is adapted to operate in a plurality of different automatic control modes to control reheating steam flow and other steam conditions, each of such modes of control permitting turbine temperature variations within predetermined constraints and according to predetermined functions of time. (Official Gazette)

17739 NUCLEAR CONTROL ROD HAVING EMBEDDED FILAMENTS. Jones, C. R. (to Transfer Systems Inc.). US Patent 3,781,191. 25 Dec 1973. Filed Date 22 Feb 1972. 6p.

A nuclear reactor control rod for regulating or shutting-down the power of a nuclear reactor is described. The control rod features filaments of a neutron absorber bonded together and to a foil backing to form a sheet. Plural sheets are laminated to form a plate, and plural plates may be joined together in a cruciform shape. A preferred method to make such a control comprises forming the sheets by plasma-spraying a corrosion-resistant metal to bond the filaments to the foil backing. (Official Gazette)

Nuclear Power Plant Economics

Refer also to abstract 15667.

17740 CASE FOR DEVELOPING SMALL POWER REACTORS. Webb, G. Nucl. Eng. Int.; 19: No. 212, 39-40(Jan 1974).

Reasons for the reluctance of international development agencies to consider assisting smaller developing countries to acquire nuclear power plants are examined, and advantages of supplying small power reactors instead of conventional plants to such countries are discussed. (UK)

17741 MARKET CONSIDERATIONS OF MEDIUM/SMALL NUCLEAR POWER REACTORS. Gregson, J. (Fairey Engineering Ltd., Stockport, Eng.). Nucl. Eng. Int.; 19: No. 212, 37-38 (Jan 1974).

The advanced industrial countries have placed great emphasis on the provision of very large reactors to the detriment of medium/small power reactors of 600 MW(e) and less. The IAEA has identified a market for some 100 power reactors in the range 300-600 MW(e). This is in the less developed countries in the ordering period up to 1983. Japanese studies predict a parallel market in the industrialized nations. It is suggested that an urgent and active programme be implemented, which is aimed at making the SGHWR as competitive as possible in sizes up to 600 MW(e) and not in the 1300 MW(e) size which has been the U. K. market requirement. (auth)

Reactor Fuel Cycle Economics

Refer also to abstract 17733.

17742 (RT/ING-(73)2) NUCLEAR REACTOR FUEL CYCLES: FUNDAMENTAL ASPECTS; TECHNOLOGY AND PROCESSING; TECHNICO-ECONOMIC EVALUATION. Bruzzi, L.; Cicognani, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1973. 571p. (In Italian). Dep. NTIS (U. S. Sales Only) $30.75.

The various features of the fuel cycle are examined for thermal and fast power reactors. The fuel behavior during reactor operation and its transformations in fabrication, reprocessing and enrichment plants are discussed. Particular attention is devoted to the main features of the various phases of the fuel cycle, pointing out the connection with reactor design, economics and safety. (auth)

17743 A LOOK AT THE FUTURE FOR URANIUM. Runnals, O. J. C. (Dept. of Energy, Mines, and Resources, Ottawa). Nucl. Can.; 12: No. 2, 5-7(Feb 1973).

It is predicted that there will be a world shortage of uranium by the early 1980's, unless exploration is expedited. Exploration in Canada has virtually ceased. It is assumed that most reactors to be built during the next decade will be of the BLW or PLW types, requiring enriched fuel that will be irradiated to about 30 GW days/tonne U. The main source of this enriched uranium will be the U. S. diffusion plants. It is estimated that total non-Communist net nuclear electrical output will increase from 19 GW in 1970 to 308 in 1980. Canadian requirements of uranium are predicted to increase only from 1% to 2% of the non-Communist total, between 1970 and 1990. Non-Communist proven and probable reserves of U_3O_8, exploitable at a cost of less than $10 per lb of U_3O_8, are each estimated at about 1 million tons (23% in Canada). Cumulative non-Communist demand will by 1985 have equalled the proven reserves exploitable at a cost of less than $10 per ton of U_3O_8. Proven reserves exploitable at $10 to $15 per ton of U_3O_8 only amount to about another 0.75 million tons. (CA)

Reactor Licensing and Regulation

Refer also to abstract 17669.

17744 (DOCKET-50003-235) INDIAN POINT STATION, UNIT 1. Information re Method of Maintaining 100% Relative Humidity During Steam/Chemical-Spray Exposure Test. (Consolidated Edison Co. of New York, Inc., New York (USA)). 15 Jan 1974. 4p. Dep. NTIS $3.00.

17745 (DOCKET-50003-236) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence Report No. AO-4-1-1: The High Pressure Boron Addition System Was Removed from Service to Permit Disassembly and Repair of Valve BA-15. (Consolidated Edison Co. of New York, Inc., New York (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

17746 (DOCKET-50003-238) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence Report No. AO-4-1-1: Inoperability of the High Pressure Boron Addition System. (Consolidated Edison Co. of New York, Inc., New York (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

17747 (DOCKET-50003-239) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence Report No. AO-4-1-2: Freezing of the Impulse Lines to the Differential Pressure Sensors; Abnormal Occurrence Report No. AO-4-1-3: Failure of the Drive Key on the No. 12 Main Steam Stop Valve Motor Operator. (Consolidated Edison Co. of New York, Inc., New York (USA)). 22 Jan 1974. 2p. Dep. NTIS $3.00.

17748 (DOCKET-50010-211) DRESDEN NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report: Core Spray Pump "B" Breaker Trip. (Commonwealth Edison Co.. Chicago, Ill. (USA)). 4 Jan 1974. 2p. Dep. NTIS $3.00.

17749 (DOCKET-50016-218) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Quarterly Report, October-December 1973. (Power Reactor Development Co., Detroit, Mich. (USA)). 17 Dec 1973. 13p. Dep. NTIS $3.00.

All component transfers from the reactor and offsite disposal of non-radioactive secondary sodium was completed. Sealing the primary system continued. Primary cold trap room piping and equipment were dismantled and removed except the piping necessary to complete the draining of the primary and service systems. Sodium was expelled with some smoke and flame when cut pipe segments in the sodium melting pipe reacted. A small sodium spill occurred while draining the storage pot into the reactor exit port, and an alcohol fire occurred in the ultrasonic clean shop. There were 1.705×10^5 liters of liquid waste, with an activity of 343.6 mCi and 8.49×10^{11} liters of gaseous waste released. Samples of airborne dust, precipitation, surface water, milk, fish and drinking water were analyzed. Tests still in effect, including the absolute filters, radiation monitor responses and calibration are described. (FS)

17750 (DOCKET-50029-285) YANKEE NUCLEAR POWER STATION. Safety Evaluation Report, Rupture of High Energy Lines Outside of Containment. (Yankee Atomic Electric Co., Westboro, Mass. (USA)). 13 Dec 1973. 5p. Dep. NTIS $3.00.

17751 (DOCKET-50029-287) YANKEE NUCLEAR POWER STATION. License Application, FSAR, Volume I. (Yankee Atomic Electric Co., Westboro, Mass. (USA)). 3 Jan 1974. 322p. Dep. NTIS $18.25.

Information is presented concerning the plant; site characteristics including geography, demography, meteorology, hydrology, geology, and seismology; the coolant system; engineered safety features; and instrumentation and control. The design criteria for structures, components and systems, and the reactor are described. (FS)

17752 (DOCKET-50029-288) YANKEE NUCLEAR POWER STATION. License Application, FSAR, Volume II. (Yankee Atomic Electric Co., Westboro, Mass. (USA)). 3 Jan 1974. 267p. Dep. NTIS $15.50.

Data concerning on- and off-site power; auxiliary systems; steam and power conversion including the turbogenerator and the main steam supply system; management of liquid, gaseous, and solid wastes; process, effluent, and offsite radiological monitoring programs; radiation protection; conduct of operations and initial tests are presented. (FS)

17753 (DOCKET-50029-289) YANKEE NUCLEAR POWER STATION. License Application, FSAR, Volume III. (Yankee Atomic Electric Co., Westboro, Mass. (USA)). 3 Jan 1974. 333p. Dep. NTIS $18.75.

Accidents including events which do not lead to radioactivity release and those which do lead to radioactivity release are discussed. Information concerning technical specifications including design features, safety limits and limiting safety settings, limiting conditions for operation, surveillance requirements, and administrative controls is presented. The quality assurance program for operation is described. (FS)

17754 (DOCKET-50155-187) BIG ROCK POINT NUCLEAR PLANT. Investigation of the Emergency Condenser to Determine the Cause of the Activity in the Shell Side Water. (Consumers Power Co., Jackson, Mich. (USA)). 21 Dec 1973. 3p. Dep. NTIS $3.00.

Following the detection of an abnormal amount of short-lived radioactivity on the shell side of the emergency condenser, an inspection was made for leakage from the tube side to the shell side. Three tubes were found leaking in the vicinity of the tube sheet of the north fuel bundle due to weld defects. In the course of the investigation, the divider plates between the inlets and outlets of the water boxes for both north and south tube bundles were found to be warped. Repairs will be made before the plant is returned to service. (JWR)

17755 (DOCKET-50155-188) BIG ROCK POINT NUCLEAR PLANT. Site Emergency Plan. (Consumers Power Co., Jackson, Mich. (USA)). 15 Jan 1974. 236p. Dep. NTIS $14.00.

17756 (DOCKET-50155-189) BIG ROCK POINT NUCLEAR PLANT. Corrective Action Taken Re Emergency Condenser. (Consumers Power Co., Jackson, Mich. (USA)). 17 Jan 1974. 7p. Dep. NTIS $3.00.

17757 (DOCKET-50171-138) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Abnormal Occurrence: Leakage Was Detected Around the Electrical Cables on the Inner Seal. (Philadelphia Electric Co., Pa. (USA)). 18 Dec 1973. 2p. Dep. NTIS $3.00.

17758 (DOCKET-50206-262) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Incident Report: CV-116, The Sphere Equalizing Valve Was Found to be Leaking Around the Valve Seat. (Southern California Edison Co., Rosemead (USA)). 14 Jan 1974. 2p. Dep. NTIS $3.00.

17759 (DOCKET-50213-257) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-73-13: Unsatisfactory Test of a Main Steam Isolation Valve. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 28 Dec 1973. 1p. Dep. NTIS $3.00.

17760 (DOCKET-50213-261) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-74-1: Unsatisfactory Test of Timers Associated With the Emergency Diesel Generator/Core Cooling Systems. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 18 Jan 1974. 2p. Dep. NTIS $3.00.

17761 (DOCKET-50213-263) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-74-3: A Severe Ice Storm Caused a Total Loss of Service Station Power. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 21 Jan 1974. 1p. Dep. NTIS $3.00.

17762 (DOCKET-50219-360) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Summary Report on Main Steam Isolation Valve Inspection and Repair. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 13 Dec 1973. 4p. Dep. NTIS $3.00.

17763 (DOCKET-50219-363) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. 73-30: Malfunction of Low Pressure Main Steam Line Pressure Switches. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 6 Dec 1973. 4p. Dep. NTIS $3.00.

17764 (DOCKET-50219-366) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-74-1: Malfunction of Low Pressure Main Steam Line Pressure Switch (RE23C). (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 15 Jan 1974. 5p. Dep. NTIS $3.00.

17765 (DOCKET-50219-367) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-74-3: Failure of Hydraulic Shock and Sway Arrestors on the Spray System and two Isolation Condenser Systems. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 14 Jan 1974. 3p. Dep. NTIS $3.00.

17766 (DOCKET-50219-368) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. 74-5: Failure of Main Steam Isolation Valve NS04A to Meet Allowable Leakage Requirements. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 17 Jan 1974. 3p. Dep. NTIS $3.00.

17767 (DOCKET-50219-369) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-74-6: Operation of the Reactor With an Inadequately Inerted Containment. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 23 Jan 1974. 4p. Dep. NTIS $3.00.

17768 (DOCKET-50219-370) OYSTER CREEK NUCLEAR PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. AO-74-7: Change in Setpoint of Sensors. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 23 Jan 1974. 3p. Dep. NTIS $3.00.

17769 (DOCKET-50219-373) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Summary of Electromatic Relief Valve Operation, January 1, 1969 to December 31, 1973. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 18 Jan 1974. 6p. Dep. NTIS $3.00.

17770 (DOCKET-50219-378) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. 73-31: Interruption of 125V dc Power Supplying Instrumentation Associated With Various Safeguard Systems. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 13 Dec 1973. 5p. Dep. NTIS $3.00.

17771 (DOCKET-50219-379) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. 73-32: Malfunction of MSIV NS04A During Closure Exercise. (Jersey Central Power and Light Co., Morristown, N.J. (USA)). 19 Dec 1973. 4p. Dep. NTIS $3.00.

17772 (DOCKET-50219-380) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Threatened Failure of Relay 6K43 in the Plant Protection System. (Jersey Central Power and Light Co., Morristown, N.J. (USA)). 20 Dec 1973. 2p. Dep. NTIS $3.00.

17773 (DOCKET-50219-381) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Malfunction of Low Pressure Main Steam Line Pressure Switches. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 24 Dec 1973. 2p. Dep. NTIS $3.00.

17774 (DOCKET-50219-382) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Momentary

Interruption of 125V dc Power Supplying Instrumentation Associated With Various Safeguard Systems. (Jersey Central Power and Light Co., Morristown, N.J. (USA)). 24 Dec 1973. 3p. Dep. NTIS $3.00.

17775 (DOCKET-50219-385) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. 73-34: Malfunction of Main Steam Line High Radiation Monitors. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 27 Dec 1973. 3p. Dep. NTIS $3.00.

17776 (DOCKET-50219-390) OYSTER CREEK NUCLEAR POWER PLANT UNIT 1. Incident Report: Spill of Chromated Water. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 3 Jan 1974. 4p. Dep. NTIS $3.00.

17777 (DOCKET-50219-391) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report: Drift in Set Point of Isolation Condenser High Flow Sensors. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 4 Jan 1974. 2p. Dep. NTIS $3.00.

17778 (DOCKET-50219-392) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. AO-74-1: Malfunction of Low Pressure Main Steam Line Pressure Switch RE23C. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 7 Jan 1974. 5p. Dep. NTIS $3.00.

17779 (DOCKET-50219-393) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Reset Problem With the Test Spool Valve for Main Steam Isolation Valve NS04A. (Jersey Central Power and Light Co., Morristown, N.J. (USA)). 7 Jan 1974. 2p. Dep. NTIS $3.00.

17780 (DOCKET-50219-394) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Failure of Main Steam Line High Radiation Monitor. (Jersey Central Power and Light Co., Morristown, N.J. (USA)). 9 Jan 1974. 2p. Dep. NTIS $3.00.

17781 (DOCKET-50219-395) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. AO-74-2: Malfunction of the RE22 Main Steam Line High Flow Sensors. (Jersey Central Power and Light Co., Morristown, N.J. (USA)). 9 Jan 1974. 3p. Dep. NTIS $3.00.

17782 (DOCKET-50237-445) DRESDEN NUCLEAR POWER STATION, UNIT 2. Abnormal Occurrences: HPCI Drain Line Leak and Torus Level Resulting from Valve Lineup Subsequent to Repairs. (Commonwealth Edison Co., Chicago, Ill. (USA)). 12 Dec 1973. 4p. Dep. NTIS $3.00.

17783 (DOCKET-50237-446) DRESDEN NUCLEAR POWER STATION, UNIT 2. Abnormal Occurrence Report: Main Steam Line High Flow Sensor Failure. (Commonwealth Edison Co., Chicago, Ill. (USA)). 24 Dec 1973. 2p. Dep. NTIS $3.00.

17784 (DOCKET-50237-448) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Unusual Occurrence: A 5-Inch Diameter Electrical Penetration Between the Reactor Building and the Turbine Building Was Found Open. (Commonwealth Edison Co., Chicago, Ill. (USA)). 11 Jan 1974. 3p. (DOCKET-50249-339). Dep. NTIS $3.00.

17785 (DOCKET-50245-324) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-12: Leakage Was Observed Issuing From the Isolation Condenser Tube Nest Boundary Flange. (Millstone Point Co., Hartford, Conn. (USA)). 31 Dec 1973. 1p. Dep. NTIS $3.00.

17786 (DOCKET-50245-325) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-12: A Steam Leak Was Discovered on One of the Isolation Condenser Tube Nest Boundary Flanges. (Millstone Point Co., Hartford, Conn. (USA)). 7 Jan 1974. 2p. Dep. NTIS $3.00.

17787 (DOCKET-50247-190) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-18: Malfunction of a Pressure Bistable in the Safety Injection Circuitry. (Consolidated Edison Co. of New York, Inc., New York (USA)). 4 Jan 1974. 2p. Dep. NTIS $3.00.

17788 (DOCKET-50247-191) INDIAN POINT STATION, UNIT 2. Feedwater Line Incident Report. (Consolidated Edison Co. of New York, Inc., New York (USA)). 14 Jan 1974. 248p. Dep. NTIS $14.50.

Following a turbine trip on November 13, 1973, due to high water level in Steam Generator No. 23, and subsequent reactor trip due to "low-low" water level in Steam Generator No. 21, a break occurred in the feedwater line to Steam Generator No. 22 just inside containment near the feedwater line penetration. An area of the containment liner adjacent to the feedwater line break was slightly bulged, apparently as a result of steam impingement. Damage to the piping system resulting from the incident has been repaired. Modifications have been made to the feedwater system to preclude recurrence of similar incidents, and insulation added to additional portions of the containment liner to preclude local buckling caused by steam impingement. The containment has been tested to show that the safety of the plant has not been compromised. Stress and other analyses, inspections and special tests were performed for affected areas of the plant. The results are reviewed as a basis for the modifications and repairs. (HDR)

17789 (DOCKET-50247-192) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-4-2-2: The Limiting Safety System Settings of Channel I and III of the Overpower ΔT Reactor Trip Circuitry Was Found to be Below Required Specification. (Consolidated Edison Co. of New York, Inc., New York (USA)). 15 Jan 1974. 2p. Dep. NTIS $3.00.

17790 (DOCKET-50247-194) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-4-2-1: the Setting of a Steam Line Pressure Bistable Associated With High Steam Flow Protection was Below Specified Level. (Commonwealth Edison Co., Chicago, Ill. (USA)). 8 Jan 1974. 2p. Dep. NTIS $3.00.

17791 (DOCKET-50247-198) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence No. AO-4-2-1: Malfunction of a Bistable Associated With High Steam Flow Protection. (Consolidated Edison Co. of New York, Inc., New York (USA)). 18 Jan 1974. 2p. Dep. NTIS $3.00.

17792 (DOCKET-50247-199) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-4-2-3: Inspection of All Bergen-Paterson Hydraulic Shock and Sway Arrestors Showed that about 350 Snubbers Did Not Meet Specifications. (Consolidated Edison Co., of New York, Inc., New York (USA)). 21 Jan 1974. 1p. Dep. NTIS $3.00.

17793 (DOCKET-50249-340) DRESDEN NUCLEAR POWER STATION, UNIT 3. Report NEDM-13357, Rod Oscillator Tests. (Commonwealth Edison Co., Chicago, Ill. (USA)). Sep 1973. 140p. Dep. NTIS $9.00.

Control rod oscillator tests were conducted to determine reactor core dynamic characteristics and to obtain neutron flux responses to small reactivity disturbances generated by control rod oscillation. The tests were an extension of the regular start-up tests and confirmed that Dresden-3 reactor complies with all stability technical specifications. (FS)

17794 (DOCKET-50249-342) DRESDEN NUCLEAR POWER STATION, UNIT 3. Unusual Event: Failure of Low Pressure Coolant Injection Valve MO3-1501-11B. (Commonwealth Edison Co., Morris, Ill. (USA)). 9 Jan 1974. 2p. Dep. NTIS $3.00.

17795 (DOCKET-50249-346) DRESDEN NUCLEAR POWER STATION, UNIT 3. Unusual Event: Primary Containment Isolation Valve Leakage. (Commonwealth Edison Co., Morris, Ill. (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

17796 (DOCKET-50259-281) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7350W: Start Circuit Failure on Standby Emergency Diesel Generator. (Tennessee Valley Authority, Chattanooga (USA)). 3 Jan 1974. 2p. Dep. NTIS $3.00.

17797 (DOCKET-50259-282) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7349W: Reactor Main Steam Relief Valve PCV-1-18 Bellows Seal Leakage Alarm Indicating Light Indicated Bellows Leakage. (Tennessee Valley Authority, Chattanooga (USA)). 4 Jan 1974. 3p. Dep. NTIS $3.00.

17798 (DOCKET-50259-283) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7348W: HPCI Failure. (Tennessee Valley Authority, Chattanooga (USA)). 4 Jan 1974. 2p. Dep. NTIS $3.00.

17799 (DOCKET-50259-286) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7385W Through 741W, Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 7 Jan 1974. 2p. Dep. NTIS $3.00.

17800 (DOCKET-50259-291) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7352W: Malfunction of Recirculation Pump A d/p Indicating Switch. (Tennessee Valley Authority, Chattanooga (USA)). 14 Jan 1974. 3p. Dep. NTIS $3.00.

17801 (DOCKET-50259-293) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7351W: Malfunction of FCV 77-2A Inboard Drywell Isola-

tion Valve. (Tennessee Valley Authority, Chattanooga (USA)). 9 Jan 1974. 2p. Dep. NTIS $3.00.

17802 (DOCKET-50259-294) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-741W: Malfunction of Reactor Water Level Switch. (Tennessee Valley Authority, Chattanooga (USA)). 15 Jan 1974. 3p. Dep. NTIS $3.00.

17803 (DOCKET-50259-295) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-742W: Malfunction of FCV 1-26 and FCV 1-51 Main Steam Inboard Isolation Valves. (Tennessee Valley Authority, Chattanooga (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

17804 (DOCKET-50259-296) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-743W: LPCI Break Detection Pressure Switches Not in Service. (Tennessee Valley Authority, Chattanooga (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

17805 (DOCKET-50259-297) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report EAO-742W Through 747W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

17806 (DOCKET-50259-305) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-744W: Start System Failure on the Standby Diesel Engine. (Tennessee Valley Authority, Chattanooga (USA)). 25 Jan 1974. 2p. Dep. NTIS $3.00.

17807 (DOCKET-50259-306) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Abnormal Occurrence Report BFAO-7343W: Correspondence Re the Status of the Torus Problem. (Tennessee Valley Authority, Chattanooga (USA)). 28 Jan 1974. 6p. (DOCKET-50260-143; DOCKET-50296-128). Dep. NTIS $3.00.

17808 (DOCKET-50260-138) BROWNS FERRY NUCLEAR POWER STATION, UNITS 2 AND 3. Interim Report on a Design Deficiency in the Control Logic of HPCI and RCIC Systems. (Tennessee Valley Authority, Chattanooga (USA)). 18 Dec 1973. 2p. (DOCKET-50296-123). Dep. NTIS $3.00.

17809 (DOCKET-50261-298) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence Report No. AO-73-72: Malfunction of Reactor Trip Breaker "B". (Carolina Power and Light Co., Raleigh, N. C. (USA)). 31 Dec 1973. 4p. Dep. NTIS $4.00.

17810 (DOCKET-50261-299) H. B. ROBINSON PLANT, UNIT 2. Additional Information Concerning Loss-of-Coolant Analyses. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 2 Jan 1974. 12p. Dep. NTIS $3.00.

17811 (DOCKET-50261-300) H. B. ROBINSON PLANT, UNIT 2. Significant Event: Deflection of Main Steam Line Seismic Restraint AP-1 Resulted in Loosening of a Small Amount of Grouting Around Restraint Anchor Plate and Misalignment of Restraint. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 4 Jan 1974. 3p. Dep. NTIS $3.00.

17812 (DOCKET-50261-302) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence Report No. AO-74-1: Dilution of the Boron Injection Tank and "B" Boric Acid Storage Tank. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 10 Jan 1974. 7p. Dep. NTIS $3.00.

17813 (DOCKET-50261-303) H. B. ROBINSON PLANT, UNIT 2. Reports on the Analysis of the First Pressure Vessel Surveillance Capsule and Correspondence. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 20 Dec 1973. 137p. Dep. NTIS $9.00

The analysis of the first vessel material surveillance capsule indicates that the response of the material to neutron-induced embrittlement was less than the maximum assumed in establishing the temperature limits for pressurization of the vessel. The calculated neutron fluence at the capsule location appears to be conservative. (FS)

17814 (DOCKET-50261-304) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence Report: the Limits For Two Representative Thimbles Were Inadvertently Changed During a Period When Maintenance Was Being Performed on the Plant Computer's Memory Core. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 17 Jan 1974. 1p. Dep. NTIS $3.00.

17815 (DOCKET-50261-305) H. B. ROBINSON PLANT, UNIT 2. Incident Report: Correspondence Summarizing Events That Transpired Following Primary to Secondary Leakage in Steam Generator C. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 17 Jan 1974. 3p. Dep. NTIS $3.00.

17816 (DOCKET-50267-100) FORT ST. VRAIN NUCLEAR GENERATING STATION. Reflector Elements for Layer Two of the Reactor did not Meet Specifications. (Public Service Co. of Colorado, Denver (USA)). 14 Jan 1974. 1p. Dep. NTIS $3.00.

17817 (DOCKET-50267-101) FORT ST. VRAIN NUCLEAR GENERATING STATION. Data on Inspection of Metal Clad Keyed Top Reflector Elements. (Public Service Co. of Colorado, Denver (USA)). 14 Jan 1974. 1p. Dep. NTIS $3.00.

17818 (DOCKET-50267-102) FORT ST. VRAIN NUCLEAR GENERATING STATION. Fuel Discrepancies Found During Fuel Loading. (Public Service Co. of Colorado, Denver (USA)). 14 Jan 1974. 1p. Dep. NTIS $3.00.

17819 (DOCKET-50269-185) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report No. 73-13: Malfunction of Reactor Building Isolation Valve LP-17. (Duke Power Co., Charlotte, N. C. (USA)). 4 Jan 1974. 2p. Dep. NTIS $3.00.

17820 (DOCKET-50269-187) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report UE-73-14: Malfunction of Engineered Safeguard Valve RC-7, a Pneumatic Operated Reactor Building Isolation Valve in the Pressurizer Sample Line. (Duke Power Co., Charlotte, N. C. (USA)). 7 Jan 1974. 2p. Dep. NTIS $3.00.

17821 (DOCKET-50269-189) OCONEE NUCLEAR STATION, UNITS 1 AND 2. Unusual Event: 230 KV Switchyard Isolation. (Duke Power Co., Charlotte, N. C. (USA)). 14 Jan 1974. 3p. (DOCKET-50270-153). Dep. NTIS $3.00.

17822 (DOCKET-50270-151) OCONEE NUCLEAR STATION, UNIT 2. Information Supporting the Continued Operation With Indicated Presence of a Loose Object in the Lower Reactor Vessel Head. (Duke Power Co., Charlotte, N. C. (USA)). 10 Jan 1974. 5p. Dep. NTIS $3.00.

17823 (DOCKET-50270-154) OCONEE NUCLEAR STATION, UNIT 2. Abnormal Occurrence Report No. AO-74-1: Reactor Coolant System Cooldown Limitations. (Duke Power Co., Charlotte, N. C. (USA)). 17 Jan 1974. 4p. Dep. NTIS $3.00.

17824 (DOCKET-50270-157) OCONEE NUCLEAR STATION, UNIT 2. Reactor Vessel Internals Inspection Following Hot Functional Testing. (Duke Power Co., Charlotte, N. C. (USA)). 25 Jan 1974. 8p. Dep. NTIS $3.00.

17825 (DOCKET-50271-263) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-32: Failure of Both Gaskets on the Gland Seal Exhaust Condenser of the HPCI System Pump. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 20 Nov 1973. 1p. Dep. NTIS $3.00.

17826 (DOCKET-50272-95) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. AEC Safety Evaluation. (Public Service Electric and Gas Co., Newark, N. J. (USA)). 16 Jul 1968. 59p. (DOCKET-50311-85). Dep. NTIS $5.00.

The reactor site and plant are described. Important safety considerations include the suitability of the site; adequacy of the engineered safety features, foundation and structural designs, instrumentation and electric power, radioactive waste disposal, and the emergency plan; conformance to design criteria; and the acceptability of the NSSS design. Further technical data are needed for the ECCS, final core design parameters, and design details of the chemical additive and the core spray systems. The report of the ACRS is also presented. (FS)

17827 (DOCKET-50277-172) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence Report: Unexplained Tripping of the RCIC Turbine During Startup Testing. (Philadelphia Electric Co., Pa. (USA)). 2 Jan 1974. 2p. Dep. NTIS $3.00.

17828 (DOCKET-50277-174) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Preliminary Abnormal Occurrence Report: Malfunction of Switches LIS-2-2-3-101C and PS-2-5-11A and D. (Philadelphia Electric Co., Pa. (USA)). 7 Jan 1974. 1p. Dep. NTIS $3.00.

17829 (DOCKET-50277-175) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence Report: Leakage From the Primary Containment to the Reactor Building. (Philadelphia Electric Co., Pa. (USA)). 8 Jan 1974. 3p. Dep. NTIS $3.00.

17830 (DOCKET-50277-177) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: Malfunction of Switches LIS-2-2-3-101C and PS-2-5-11A and D. (Philadelphia Electric Co., Pa. (USA)). 15 Jan 1974. 3p. Dep. NTIS $3.00.

17831 (DOCKET-50277-179) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence Report No. AO-74-2: Failure of the LIS-2-3-231D Switch Which Provides a Scram Discharge Volume High Level Trip Input to the RPS Logic. (Philadelphia Electric Co., Pa. (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

17832 (DOCKET-50280-205) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-73-16: Loss of Overhead Gas System Pressure. (Virginia Electric and Power Co., Richmond (USA)). 19 Dec 1973. 9p. Dep. NTIS $3.00.

17833 (DOCKET-50280-206) SURRY POWER STATION, UNITS 1 AND 2. Unusual Safety Related Event Report No. USRE-S1-73-04: Design Problems in the CLS System Pressure Sensing System. (Virginia Electric and Power Co., Richmond (USA)). 19 Dec 1973. 7p. (DOCKET-50281-168). Dep. NTIS $3.00.

17834 (DOCKET-50280-207) SURRY POWER STATION, UNITS 1 AND 2. Report on a Reactor Coolant Pump Shaft Failure. (Virginia Electric and Power Co., Richmond (USA)). 9 Jan 1974. 10p. (DOCKET-50281-170). Dep. NTIS $3.00.

17835 (DOCKET-50280-208) SURRY POWER STATION, UNIT 1. Unusual Safety Related Event: Failure of the Primary Loop B Stop Valve. (Virginia Electric and Power Co., Richmond (USA)). 17 Jan 1974. 1p. Dep. NTIS $3.00.

17836 (DOCKET-50281-169) SURRY POWER STATION, UNIT 2. Abnormal Occurrence Report No. AO-S2-73-12: Violation of Containment Integrity When the Emergency Access Hatch in the Inner Access Door of the Personnel Air Lock Opened While the Outer Door Was Opened. (Virginia Electric and Power Co., Richmond (USA)). 20 Dec 1973. 2p. Dep. NTIS $3.00.

17837 (DOCKET-50282-193) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Environmental Monitoring and Ecological Studies Program, Annual Report, 1972. (Northern States Power Co., Minneapolis, Minn. (USA)). Oct 1973. 754p. (DOCKET-50306-152). Dep. NTIS $39.75.

Information is presented concerning film badge background radiation exposures at on- and off-site locations, gamma dosage measured with TLDs, and levels of radioactivity of Minnesota compared to other localities throughout the U. S. Parameters analyzed included air particulates, fallout, milk, river water, river bottom sediment, and top soil. Ecological studies on zooplankton, invertebrates, fish, aquatic vegetation, water chemistry, and river temperatures are reported. (FS)

17838 (DOCKET-50282-198) PRAIRE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence Report: Incorrect Containment Spray Caustic Addition System Valve Lineup. (Northern States Power Co., Minneapolis, Minn. (USA)). 4 Jan 1974. 1p. Dep. NTIS $3.00.

17839 (DOCKET-50285-151) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-12: Cracks in Component Cooling Water Pump Impellers. (Omaha Public Power District, Nebr. (USA)). 17 Dec 1973. 6p. Dep. NTIS $3.00.

17840 (DOCKET-50285-153) FORT CALHOUN STATION, UNIT 1. Abnormal Occurrence Report No. 73-6: Diesel Generator (D-1) Starting Failure. (Omaha Public Power District, Nebr. (USA)). 13 Dec 1973. 3p. Dep. NTIS $3.00.

17841 (DOCKET-50285-162) FORT CALHOUN STATION, UNIT 1. Additional Information on the Steam Line Vibration Problem. (Omaha Public Power District, Nebr. (USA)). 31 Sec 1973. 2p. Dep. NTIS $3.00.

17842 (DOCKET-50285-162) FORT CALHOUN STATION, UNIT 1. Abnormal Occurrence Report No. 73-8: Malfunction of Main Steam Isolation Valve HCV-1041A. (Omaha Public Power District, Nebr. (USA)). 2 Jan 1974. 3p. Dep. NTIS $3.00.

17843 (DOCKET-50285-163) FORT CALHOUN STATION, UNIT 1. Environmental Radioactivity Surveillance Program Preoperational Report, Second Quarter, 1973. (Omaha Public Power District, Nebr. (USA)). 1973. 35p. Dep. NTIS $3.75.

TLD data for the second quarter of 1973 indicated an average background radiation dose rate of 2.18 mrem/week. Charcoal cartridges (KI impregnated) were used to sample airborne I-131 during May and June. The amount of I-131 present was below the limit of detection for all samples, which corresponds to 0.09 to 0.37 pCi/m^3 depending on sample volume and time delay between sample collection and counting. Beta radioactivity in air particulate samples remained at very low concentrations for the period, ranging from less than 0.01 to 0.04 pCi/m^3. The major gamma emitter present was Be-7 with concentrations ranging from 0.015 to 0.12 pCi/m^3. The Be-7 is produced naturally by cosmic-ray bombardment. Beta radioactivity in surface water ranged from 10 to 23 pCi/l. This is within the normal range for surface water. The highest concentrations were observed in samples that contained a large amount of suspended silt which contains K-40, Ra-226, and other natural radionuclides. Tritium concentrations did not exceed 1.0 pCi/ml. Beta radioactivity in well water was below 10 pCi/l. The only gamma emitters detected in fish and other aquatic biota was natural K-40. Silt samples indicated the presence of the decay products of uranium and thorium along with natural K-40. Sr-90 was measured by radiochemistry at a concentration ranging from 0.05 to 1.51 pCi/g (dry) and is attributable to worldwide fallout. Almost all of the beta radioactivity in milk is due to natural K-40. The concentration of Cs-137 in milk was below the detectable limit of 18 pCi/l. Sr-90 was measured by radiochemistry with concentrations below 10 pCi/l and is attributable to worldwide fallout. Radiochemical analysis of I-131 in milk was initiated in June. All the samples analyzed showed an activity less than the minimum detectable level of 0.2 pCi/l. (auth)

17844 (DOCKET-50285-164) FORT CALHOUN STATION, UNIT 1. Abnormal Occurrence Report: Failure of Diesel Generators. (Omaha Public Power District, Nebr. (USA)). 10 Jan 1974. 2p. Dep. NTIS $3.00.

17845 (DOCKET-50285-167) FORT CALHOUN STATION, UNIT 1. Reactor Coolant Flow Evaluation. (Omaha Public Power District, Nebr. (USA)). 17 Jan 1974. 16p. Dep. NTIS $3.00.

17846 (DOCKET-50289-149) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Incident Report: Discrepancies Noted Between Physical Cable Count and the Cable Tray Loading Summary Quantities. (Metropolitan Edison Co., Reading, Pa. (USA)). 12 Dec 1973. 3p. Dep. NTIS $3.00.

17847 (DOCKET-50293-215) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence Report No. 73-19: Failure of the Inverter for the RCIC System. (Boston Edison Co., Mass. (USA)). 10 Dec 1973. 1p. Dep. NTIS $3.00.

17848 (DOCKET-50293-216) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence Report No. UO-73-20: Malfunction of Containment Spray Valve MO-1001-23A. (Boston Edison Co., Mass. (USA)). 20 Dec 1973. 1p. Dep. NTIS $3.00.

17849 (DOCKET-50293-217) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-39: Malfunction of a Barton Model 288A Differential Pressure Indicating Switch. (Boston Edison Co., Mass. (USA)). 21 Dec 1973. 1p. Dep. NTIS $3.00.

17850 (DOCKET-50293-219) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-29: Malfunction of Barton Model 288A Differential Pressure Indicating Switch. (Boston Edison Co., Mass. (USA)). 15 Dec 1973. 1p. Dep. NTIS $3.00.

17851 (DOCKET-50293-222) PILGRIM NUCLEAR POWER STATION, UNIT 1. Progress Report on Determining Minimum Rates and Duration of Sodium Hypochlorite Addition. (Boston Edison Co., Mass. (USA)). 7 Jan 1974. 11p. Dep. NTIS $3.00.

17852 (DOCKET-50293-223) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-74-1: the General Purpose Grapple Became Detached During Refueling Activities in the Spent Fuel Pool. (Boston Edison Co., Mass. (USA)). 11 Jan 1974. 2p. Dep. NTIS $3.00.

17853 (DOCKET-50293-224) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence No. AO-74-2: While Transferring an Irradiated Fuel Bundle, the Refueling Grapple Lowered and the Fuel Bundle Bumped Into the Side of the Reactor Vessel. (Boston Edison Co., Mass. (USA)). 14 Jan 1974. 1p. Dep. NTIS $3.00.

17854 (DOCKET-50295-221) ZION NUCLEAR PLANT, UNIT 1. Special Report No. 4, Post-Tensioning System Initial Surveillance. (Commonwealth Edison Co., Chicago, Ill. (USA)). 5 Dec 1973. 41p. Dep. NTIS $4.25.

17855 (DOCKET-50295-224) ZION NUCLEAR PLANT, UNIT 1. Report No. 1C, Main Steam Line Check Valve Differential Pressure Exceeding 35 PSID, and Appendix A. (Commonwealth Edison Co., Chicago, Ill. (USA)). 24 Dec 1973. 8p. Dep. NTIS $3.00.

17856 (DOCKET-50295-226) ZION NUCLEAR PLANT, UNITS 1 AND 2. Fish Population Study Program. (Commonwealth Edison Co., Chicago, Ill. (USA)). 7 Jan 1974. 158p. (DOCKET-50304-145). Dep. NTIS $10.00.

Information is presented concerning condenser water discharge plumes under winter conditions, baseline information providing an outline of the monitoring effort since 1970, and September and

October 1973 progress in monitoring fish number, species, and weight. (FS)

17857 (DOCKET-50295-229) ZION NUCLEAR PLANT, UNITS 1 AND 2. Abnormal Occurrence Report: Malfunction of Diesel Generator O Feedbreaker. (Commonwealth Edison Co., Chicago, Ill. (USA)). 14 Jan 1974. 3p. (DOCKET-50304-148). Dep. NTIS $3.00.

17858 (DOCKET-50295-230) ZION NUCLEAR PLANT, UNIT 1. Special Report No. 5, Power Distribution Anomalies in Low Power Tests. (Commonwealth Edison Co., Chicago, Ill. (USA)). 16 Jan 1974. 19p. Dep. NTIS $3.00.

17859 (DOCKET-50295-233) ZION NUCLEAR PLANT, UNIT 1. Abnormal Occurrence Report: Safety Injection Actuation. (Commonwealth Edison Co., Zion, Ill. (USA)). 18 Jan 1974. 3p. Dep. NTIS $3.00.

17860 (DOCKET-50302-112) CRYSTAL RIVER NUCLEAR PLANT, UNIT 3. Report on Nonconformance Which Occurred During the Installation of Nuclear Service Sea Water Piping. (Florida Power Corp., St. Petersburg (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

17861 (DOCKET-50305-143) KEWAUNEE NUCLEAR POWER PLANT. Final Report on Lightning Protection. (Wisconsin Public Service Corp., Green Bay (USA)). 15 Jan 1974. 3p. Dep. NTIS $3.00.

17862 (DOCKET-50305-144) Kewaunee Nuclear Power Plant. Final Report on Problems Experienced With the 4 KV Circuit Breakers. (Wisconsin Public Service Corp., Green Bay (USA)). 22 Jan 1974. 3p. Dep. NTIS $3.00.

17863 (DOCKET-50309-168) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence Report No. AO-74-1: Malfunction of Pressure Switches on the High Containment Pressure Protective Channels. (Maine Yankee Atomic Power Co., Westboro, Mass (USA)). Jan 1974. 1p. Dep. NTIS $3.00.

17864 (DOCKET-50317-146) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Interim Report on a Significant Deficiency: Plant Electric Service Supply Failure. (Baltimore Gas and Electric Co., Md. (USA)). 11 Jan 1974. 3p. (DOCKET-50318-124). Dep. NTIS $3.00.

17865 (DOCKET-50317-147) CALVERT CLIFFS NUCLEAR PLANT, UNITS 1 AND 2. Interim Report on Significant Deficiency, Missing Drive Key in Butterfly Valve Drive Arm. (Baltimore Gas and Electric Co., Md. (USA)). 11 Jan 1974. 3p. (DOCKET-50318-125). Dep. NTIS $3.00.

17866 (DOCKET-50317-150) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Significant Deficiency Report: Use of Unacceptable Thermocouple Well Material. (Baltimore Gas and Electric Co., Md. (USA)). 14 Jan 1974. 3p. (DOCKET-50318-128). Dep. NTIS $3.00.

17867 (DOCKET-50324-125) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Report on Control Rod Blade Inverted Absorber and Correspondence. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 26 Dec 1973. 4p. (DOCKET-50325-128). Dep. NTIS $3.00.

17868 (DOCKET-50324-135) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Incident Report: Mismatch of Valve Actuators. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 14 Jan 1974. 2p. (DOCKET-50325-132). Dep. NTIS $3.00.

17869 (DOCKET-50327-68) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 8. (Tennessee Valley Authority, Chattanooga (USA)). 1973. 397p. (DOCKET-50328-61). Dep. NTIS $22.00.

Information is presented concerning liquid, gaseous, and solid waste management; process, effluent, and offsite radiological monitoring programs; shielding; ventilation; and the health physics program. The organizational structure of the applicant, the training program, emergency plan, review and audit, plant instructions and records, and industrial security are explained. (FS)

17870 (DOCKET-50327-69) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. License Application, Technical Specifications. (Tennessee Valley Authority, Chattanooga (USA)). 1973. 398p. (DOCKET-50328-62). Dep. NTIS $22.00.

Technical specifications are presented concerning safety limits and limiting safety system settings, limiting conditions for operation, surveillance requirements, administrative controls, and design features of the site, containment, reactor, and fuel storage. (FS)

17871 (DOCKET-50327-70) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 7. (Tennessee Valley Authority, Chattanooga (USA)). 1973. 647p. (DOCKET-50328-63). Dep. NTIS $34.50.

Descriptions are presented concerning fuel storage and handling; heating; ventilation; air conditioning; water systems; and systems for compressed air, process sampling, equipment and floor drainage, chemical and volume control, failed fuel detection, auxiliary charging; fire detection, plant communications, lighting, hydrogen, nitrogen; and diesel generator fuel oil, cooling water, and lubrication systems. The turbine generator, main steam supply system, main condenser, turbine gland sealing, turbine bypass, and condenser circulating water system are described. (FS)

17872 (DOCKET-50329-60) MIDLAND PLANT, UNITS 1 AND 2. Deficiencies in the Cadwelding Quality Assurance Program. (Consumers Power Co., Jackson, Mich. (USA)). 10 Dec 1973. 3p. (DOCKET-50330-59). Dep. NTIS $3.00.

17873 (DOCKET-50336-194) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Final Report for Deficiency Report No. 6, Examination of Velan Valve Bonnets. (Millstone Point Co., Hartford, Conn. (USA)). 30 Nov 1973. 3p. Dep. NTIS $3.00.

17874 (DOCKET-50382-86) WATERFORD STATION, UNIT 3. License Application, Environmental Report, Supplement 7. (Louisiana Power and Light Co., New Orleans (USA)). 9 Jan 1974. 36p. Dep. NTIS $4.00.

17875 (DOCKET-50397-56) WPPSS NUCLEAR PROJECT NO. 2. Design Criteria for Inactive Pumps and Values. (Washington Public Power Supply System, Richland (USA)). 14 Jan 1974. 9p. Dep. NTIS $3.00.

17876 (DOCKET-50400-61) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. AEC Revised Draft Environmental Statement. (Carolina Power and Light Co., Raleigh, N. C. (USA)). Jan 1974. 241p. (DOCKET-50401-61; DOCKET-50402-61; DOCKET-50403-61). Dep. NTIS $14.25.

The environmental effects of construction and operation of the Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost and analysis of the proposed plant operation. (FS)

17877 (DOCKET-50409-85) LA CROSSE BOILING WATER REACTOR. Analysis of the First Vessel Material Surveillance Capsule Withdrawal. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 29 Nov 1973. 58p. Dep. NTIS $5.00.

The first withdrawal of vessel material surveillance specimens from the LaCrosse Boiling Water Reactor (LACBWR) was made during an outage in August, 1972, at which time the total power generated by the reactor was equivalent to 1.42 years of full power operation. The analysis of the results obtained indicates that the vessel weld metal is more sensitive to nil-ductility transition (NDT) temperature shifts than are the vessel plates as expected. However, the shift in NDT temperature of the weld metal in the vessel wall after 20 full power years of operation is projected to be approximately 150°F, which is within the range originally predicted for the vessel materials in the design calculations as reported in ACNP 66517. (auth)

17878 (DOCKET-50409-92) LACROSSE BOILING WATER REACTOR. Technical Evaluation of the Reactor Emergency Core Cooling System. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 10 Jan 1974. 46p. Dep. NTIS $4.50.

17879 (DOCKET-50466-4) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 3. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 319p. (DOCKET-50467-3). Dep. NTIS $18.00.

Information concerning the geology and seismology of the reactor site is presented including basic geologic and seismic information, vibratory ground motion, surface faulting, stability of subsurface materials, and slope stability. (FS)

17880 (DOCKET-50466-9) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 9. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 384p. (DOCKET-50467-9). Dep. NTIS $21.25.

Design data are presented concerning the following systems: compressed air, process sampling, equipment and floor drainage, chemical, volume control, liquid poison, air conditioning, heating, ventilation, fire protection, communications, plant lighting, and diesel generator cooling water, starting, and lubrication. Major components of the steam and power conversion system, which include the turbine-generator, main condenser, condensate pumps, steam jet air ejectors, turbine gland sealing, turbine bypass,

condensate demineralizer, feedwater heater, feed pumps and the condensate storage facility are described. Management of gaseous, liquid, and solid wastes and the process, effluent, and off site radiological monitoring programs are discussed. (FS)

17881 (IAEA-151, pp 467-482) LEGISLATIVE AND REGULATORY REQUIREMENTS FOR THE INTRODUCTION OF NUCLEAR POWER. Ha Vinh, P. (International Atomic Energy Agency, Vienna). 1972.

Some information about legislative and regulatory requirements for the introduction of nuclear power are given. Legislative provisions and regulatory measures are required because of the need: to protect the public health and safety and the environment by providing reasonable assurance that authorized nuclear facilities are located, designed, constructed and operated in such a way as to have a minimum of impact on the environment, to prevent accidents from occurring, and to mitigate their consequences if they should occur; and to ensure adequate financial protection for third parties in the event of an occurrence causing nuclear damage in view of the special nature and potential magnitude of such damage. The following problems; --licensing regulations and procedures --legislation on nuclear liability and --the IAEA advisory services in nuclear legislation are stressed. (INIS)

17882 (PRDI-74-1) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION. (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 50p.

Citations and subject indexing to be documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

17883 (RAI-73-12) REGULATORY ADJUDICATION ISSUANCES, DECEMBER 1973. (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 111p.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (DCC)

17884 (REG/G-1.3(Rev. 1)(6-73)) ASSUMPTIONS USED FOR EVALUATING THE POTENTIAL RADIOLOGICAL CONSEQUENCES OF A LOSS OF COOLANT ACCIDENT FOR BOILING WATER REACTORS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 12p. DRS.

17885 (REG/G-1.4(Rev. 1)(6-73)) ASSUMPTIONS USED FOR EVALUATING THE POTENTIAL RADIOLOGICAL CONSEQUENCES OF A LOSS OF COOLANT ACCIDENT FOR PRESSURIZED WATER REACTORS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 6p. DRS.

17886 (REG/G-1.16)(Rev. 1)(10-73)) REPORTING OF OPERATING INFORMATION. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Oct 1973. 8p. DRS.

17887 (REG/G-1.17(6-73)) PROTECTION OF NUCLEAR POWER PLANTS AGAINST INDUSTRIAL SABOTAGE. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jun 1973. 2p. DRS.

17888 (REG/G-1.31(Rev. 1)(6-73)) CONTROL OF STAINLESS STEEL WELDING. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 3p. DRS.

An acceptable method is described for implementing requirements for the control of welding when fabricating and joining austenitic stainless steel components and systems for water cooled reactors. (HDR)

17889 (REG/G-1.42(6-73)) INTERIM LICENSING POLICY ON AS LOW AS PRACTICABLE FOR GASEOUS RADIOIODINE RELEASES FROM LIGHT-WATER-COOLED NUCLEAR POWER REACTORS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jun 1973. 31p. DRS.

17890 (REG/G-1.49(Rev. 1)(12-73)) POWER LEVELS OF NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 2p. DRS.

This guide describes acceptable maximum power levels for all nuclear power plants and explains the policy for increasing the power levels of future reactors. (TFD)

17891 (REG/G-1.51(5-73)) INSERVICE INSPECTION OF ASME CODE CLASS 2 AND 3 NUCLEAR POWER PLANT COMPONENTS. (USAEC Directorate of Regulatory Standards. Washington, D. C.). May 1973. 2p. DRS.

17892 (REG/G-1.52(6-73)) DESIGN, TESTING, AND MAINTENANCE CRITERIA FOR ATMOSPHERE CLEANUP SYSTEM AIR FILTRATION AND ADSORPTION UNITS OF LIGHT-WATER-COOLED NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 9p. DRS.

17893 (REG/G-1.53(6-73)) APPLICATION OF THE SINGLE-FAILURE CRITERION TO NUCLEAR POWER PLANT PROTECTION SYSTEMS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 2p. DRS.

17894 (REG/G-1.54(6-73)) QUALITY ASSURANCE REQUIREMENTS FOR PROTECTIVE COATINGS APPLIED TO WATER-COOLED NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 2p. DRS.

This guide describes an acceptable method of complying with the Commission's quality assurance requirements with regard to protective coatings applied to ferritic steels, aluminum, stainless steel, zinc-coated (galvanized) steel, concrete, or masonry surfaces of water-cooled nuclear power plants. (TFD)

17895 (REG/G-1.55(6-73)) CONCRETE PLACEMENT IN CATEGORY 1 STRUCTURES. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jun 1973. 3p. DRS.

17896 (REG/G-1.57(6-73)) DESIGN LIMITS AND LOADING COMBINATIONS FOR METAL PRIMARY REACTOR CONTAINMENT SYSTEM COMPONENTS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jun 1973. 6p. DRS.

17897 (REG/G-1.58(8-73)) QUALIFICATION OF NUCLEAR POWER PLANT INSPECTION, EXAMINATION, AND TESTING PERSONNEL. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Aug 1973. 2p. DRS.

17898 (REG/G-1.60(Rev. 1)(12-73)) DESIGN RESPONSE SPECTRA FOR SEISMIC DESIGN OF NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 6p. DRS.

17899 (REG/G-1.62(10-73)) MANUAL INITIATION OF PROTECTIVE ACTIONS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Oct 1973. 2p. DRS.

17900 (REG/G-1.63(10-73)) ELECTRIC PENETRATION ASSEMBLIES IN CONTAINMENT STRUCTURES FOR WATER-COOLED NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Oct 1973. 2p. DRS.

17901 (REG/G-1.65(10-73)) MATERIALS AND INSPECTIONS FOR REACTOR VESSEL CLOSURE STUDS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Oct 1973. 4p. DRS.

17902 (REG/G-1.66(10-73)) NONDESTRUCTIVE EXAMINATION OF TUBULAR PRODUCTS. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Oct 1973. 3p. DRS.

17903 (REG/G-1.67(10-73)) INSTALLATION OF OVERPRESSURE PROTECTION DEVICES. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Oct 1973. 2p. DRS.

17904 (REG/G-1.68(11-73)) PREOPERATIONAL AND INITIAL STARTUP TEST PROGRAMS FOR WATER-COOLED POWER REACTORS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Nov 1973. 12p. DRS.

17905 (REG/G-1.69(12-73)) CONCRETE RADIATION SHIELDS FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 2p. DRS.

17906 (REG/G-1.70.1(12-73)) HYDROLOGICAL CONSIDERATIONS FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 2p. DRS.

This guide identifies information related to hydrological considerations that has often been missing from the applicant's safety analysis report at the construction permit and operating licensing stages of review. (TFD)

17907 (REG/G-1.71(12-73)) WELDER QUALIFICATION FOR AREAS OF LIMITED ACCESSIBILITY. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 2p. DRS.

17908 (REG/G-1.72(12-73)) SPRAY POND PLASTIC PIPING. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 3p. DRS.

This guide describes a method acceptable for implementing the requirements with regard to the design, fabrication, and testing of fiberglass-reinforced thermosetting plastic piping for spray pond applications. The guide applies to light-water-cooled and gas-cooled reactors. (TFD)

17909 (REG/G-2.1(5-73)) SHIELD TEST PROGRAM FOR EVALUATION OF INSTALLED BIOLOGICAL SHIELDING IN RESEARCH AND TRAINING REACTORS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). May 1973. 2p. DRS.

GENERAL

Refer also to abstracts 15929 and 15975.

Energy Utilization and Economics

17910 (ORNL-tr-2779) UNDEVELOPED ENERGY RESERVES FOR PRODUCTION OF ELECTRICAL POWER. Attempt at a Realistic Method of Consideration. Franzen, L. F.; Merton, A. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Cologne (F.R. Germany)). Sep 1972. Translation by R. G. Mansfield of IRS-S-7. 23p. Dep. NTIS $3.25.

Energy reserves must be examined from two different viewpoints—their natural occurrence and potentials for use. Solar energy has an enormous, practically inexhaustible power potential. The technology for its conversion to electrical energy is in its infancy. Equipment already developed for this purpose is complicated and cumbersome, has a poor efficiency, and is therefore expensive. The power potential in water, at 2.9×10^6 MW, is large. Although on a worldwide scale still largely unexploited, water energy is nearly exhausted in industrial nations, especially Western Europe. Tidal energy can be tapped on a large scale only in small coastal areas. Nuclear fusion opens up excellent possibilities for the future production of energy. Upon realization of the deuterium–deuterium reaction, an enormous energy reserve will become available. Along with the use of fossil fuels, whose contribution to the production of electrical energy must not be discounted for some time to come, only nuclear energy offers adequate potentials to meet the demands for energy throughout the world. Geothermal energy is discussed, but is considered of no economic worth. (MCW)

17911 (WASH-1261) ENVIRONMENTAL IMPACT OF ELECTRICAL POWER GENERATION: NUCLEAR AND FOSSIL. A Minicourse for Secondary Schools and Adult Education. (Pennsylvania Dept. of Education, Harrisburg (USA)). 1973. Contract AT(40-1)-4167. 96p. GPO $1.25.

The advantages and disadvantages of the methods of generating electrical power are discussed in the minicourse for secondary schools and adult education. The eight chapters are: The Demand for Electric Energy; Meeting the Demand for Electrical Energy; Nuclear Power Plants; Fossil Fueled Electrical Generating Stations; Biological Effects: A Comparison; Wastes in the Production of Electric Power; Plant Site Considerations; and Energy Conservation: The Need for More Efficient Use of Energy. Additional data are available in four appendices. (MCW)

17912 (WASH-1262) TEACHER'S GUIDE FOR THE ENVIRONMENTAL IMPACT OF ELECTRICAL POWER GENERATION: NUCLEAR AND FOSSIL. A Minicourse for Secondary Schools and Adult Education. (Pennsylvania Dept. of Education, Harrisburg (USA)). Nov 1973. Contract AT(40-1)-4167. 165p. GPO $1.70.

Pertinent information relevant to decision making as to the generation of electrical energy using either nuclear or fossil fuels is summarized. The advantages and disadvantages of each method of electrical generation are discussed in relation to health hazards to the general population. The material was assembled for use as a teacher's guide for studies on the environmental impact of electrical power generation. (CH)

17913 COAL GASIFICATION. Hegarty, W. P.; Say, D. L. (to Air Products and Chemicals, Inc.). US Patent 3,779,725. 18 Dec 1973. Filed date 6 Dec 1971. 8p.

A method is described for producing a synthetic pipeline gas by reacting a carbonaceous fuel in a gasifier. The gas is subjected to additional process steps including a final cryogenic separation of high methane content gas for use as the pipeline gas. (auth)

17914 GEOTHERMY AND ITS FUTURE IN INDONESIA. Zen, M. T. (Inst. of Tech., Bandung, Indonesia). Proc., Inst. Teknol. Bandung; 7: No. 1, 27–40(1973).

The basic concept of a commercial steam-field is discussed and potential areas are indicated in a map. It is found that not less than 24 geothermal areas are prospectable, but very little is known about the exact potential of Indonesia in the field of geothermy. Anticipating the rising demand in electricity within the context of the broader industrialization program of Indonesia and the limitation of its fossil fuel reserve, it is suggested that all possibilities for utilizing different kinds of energy, including geothermy, should be explored as far as possible. (auth)

17915 POTENTIAL FOR THE PRODUCTION OF POWER FROM GEOTHERMAL RESOURCES. Smith, M. C. (Los Alamos Scientific Lab., NM). Geotherm. Energy Mag.; 1: No. 2, 46-51(Sep 1973).

Testing is being carried out at the Los Alamos Scientific Laboratory to investigate the possibilities, problems, and probable usefulness of man-made geothermal-energy systems in hot dry rock. The geothermal energy in the Earth's crust is the largest reservoir of directly usable clean energy accessible to man. The extraction system, potential, and costs are discussed. Equipment and techniques to make this energy reservoir useful already exist. (MCW)

17916 PUBLIC POWER COUNCIL PRESENTS 10-YEAR GEOTHERMAL PROGRAM. Geotherm. Energy Mag.; 1: No. 2, 30-32 (Sep 1973).

It is advised that a joint industrial–government program be approached for a total geothermal research and development program. Existing geothermal installations have environmentally undesirable discharges of gas, liquids, and minerals. Research, development, and evaluation of well design appear necessary to avoid well failure that may result in uncontrolled surface or subsurface release of undesirable materials. (MCW)

17917 ENERGY CRISES IN PERSPECTIVE. Fisher, J. C. (General Electric Co., New York). Phys. Today; 26: No. 12, 40-44; 49; 51(Dec 1973).

Estimates of US energy resources and projections of future energy consumption show that the country has enough fossil fuel to last 500 years and enough nuclear fuel to last for a million years. If nuclear fuels or other fuels take part of the energy demand, fossil fuels will last longer. The present energy crisis was caused by many factors. The unanticipated environmental movement precipitated a crisis in the US because more petroleum products and more refinery capacity were needed as consumers shifted to oil from coal and from planned uranium. Natural-gas price regulation was a factor. The uncertain viability of high-cost US crude oil and refined products in the face of a potential flood of low-cost imported crude oil and refined products inhibited US petroleum development and refinery construction. The projected energy consumption, with data on energy sources and reserves, is discussed. In the long-term, progress in technologies and the advent of synthetic oil from coal or shale is expected. (MCW)

17918 HYDROCRACKING OF MONTANA COALS THROUGH THE USE OF MASSIVE QUANTITIES OF MOLTEN SALT CATALYSTS. Scarrah, W. P. Bozeman, MT; Montana State Univ. (1973). 109p. University Microfilms Order No. 73-27,492.

Thesis (Ph. D.).

The use of massive quantities of molten salt catalysts was investigated for the hydrocracking of two Montana coals: Colstrip sub-bituminous and Savage lignite. The catalytic component of the molten salt was $ZnCl_2$; various alkali metal halides were used as the noncatalytic component to reduce the viscosity of the molten salt and promote phase separation between the hydrocarbons and salt mixture. Experiments were run in a 500-ml rocking-bomb reactor and conversions were based on reaction products soluble in benzene. Tests used to simultaneously investigate the importance on conversion of seven process parameters showed no effect of the following between the levels indicated: pressure (2000 to 3000 psig); salt : coal weight ratio (2 : 1 to 4 : 1); and KCl : $ZnCl_2$ mole ratio (1 : 2 to 1 : 1). Significant effects were attributed to these parameters between the levels indicated: temperature (350 to 450°C); time (15 to 60 min.); mixing (static-rocking); and coal size (–40 + 100 to –100 mesh). Good conversions (>85 wt %) were attained using both coals and the parameters affected conversion essentially the same for both coals. Additional tests showed that the pressure should be greater than 2000 psig and the coal particle size smaller than 140 mesh. It was also observed that KCl : $ZnCl_2$ mole ratios as low as 0.2 : 1 might be feasible and that the noncatalytic component of the slat mixture affects conversion and product appearance. NaCl was superior to KCl relative to conversion when used as the noncatalytic component of the salt mixture. The $ZnCl_2$ in the molten salt mixture eventually became poisoned with resultant lower conversions, poorer phase separations, and more tar-like products. The use of expendable quantities of $ZnCl_2$ in noncatalytic molten salt mixtures was not promising. Metal chlorides of metals more and less active than zinc did not act as catalyst accelerators (compounds that would react with the catalyst poisons in preference to $ZnCl_2$). Comparisons of gas removal at reactor operating temperatures and at ambient temperatures showed the former retarded the onset of poor phase separation and more tar-like products. It also resulted in a higher H : C mole ratio in the products and less retention of nitrogen (the suspected catalyst poison) in the salt mixture. (Diss. Abstr. Int.; B)

17919 FLYWHEELS. Post, R. F.; Post, S. F. Sci. Amer.; 229: No. 6, 17-23(Dec 1973).

The flywheel offers the prospect of providing an efficient means of storing energy on a large scale to help electric utilities handle peak loads and for compact units to power electric vehicles having a range and performance comparable to those of the automobiles, trucks, and buses on the roads today. It is believed that the improved flywheel can offer storage at lower costs than is required for the pumped-storage plants. The development and advantages of fiber-composite flywheels are discussed. (MCW)

17920 R AND D PRIORITIES AND FUNDING: THE YEAR OF DECISION. Papamarcos, J. (ed.) Power Eng.; 77: No. 9, 52-59 (Sep 1973).

The research and development for energy use was reviewed with existing technology and mid-term and long-term planning. It was shown that the energy crisis or crunch can be improved and that the technology can be developed for practically unlimited clean energy in the future. Proper planning and timely decisions are urgently needed. None of the priorities are accepted without argument. Proved and estimated reserves of all fuels, present and projected demands for all fuels, environmental restraints on production of fuels, present and future environmental restraints on siting and operating various types of power plants, present and future environmental restraints on transmission and distribution of electric power, and present and future environmental restraints on high capacity pipelines for transmission of gaseous fuels are all subjects of controversy, not to mention the allotting of the funds appropriated for researches. An Energy Policy Council, an Energy RD&D Agency, and a National Energy RD&D Planning Body are proposed. (MCW)

17921 ENERGY, ECONOMIC GROWTH, AND THE ENVIRONMENT. Conference Held at Washington, DC, April 20-21, 1971. Schurr, S. H. (ed.). Baltimore; Johns Hopkins University Press (1973). 238p. (CONF-710471-).

The complex relationship between the use of energy, economic growth, and the quality of the environment is examined in eight papers. The economic growth is discussed by Heller and Commoner offering their views regarding society's requirements to assure both social and biological survival. Sporn, Gonzalez, and MacDonald examine the effects of rising energy consumption on environmental quality and of regulations on the availability and cost of energy. Mason, Seaborn, and Boulding discuss possible institutional and technological means of meeting the increased demand for energy while achieving desirable environmental objectives as well. In an appendix, Darmstadter presents data on trends and patterns of energy consumption in the USA and the world. (MCW)

17922 SOCIETAL ASPECTS OF TECHNOLOGY. Rubinstein, E. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 11: No. 1, 86-90 (Jan 1974).

With the advent of the energy crisis, the citizen experienced layoffs, shortages, strikes, financial insecurity, and inconveniences. The gaps that are evident in society are discussed. The causes of the crisis and the lack of forecasts are investigated. It is concluded that the engineer as technologist, consumer, and citizen has been forced to reassess his social role. Also, the technologist must join in the procedure of policy planning through his technical society. (MCW)

17923 DETROIT EDISON HAS CONFIDENCE IN SO_2 SCRUBBER. Elec. Light Power, E/G Ed.; 52: No. 1, 22 (Jan 1974).

A sulfur removal system for Detroit Edison's St. Clair station that burns high-sulfur coal was designed by Peabody Engineering. The pilot facility is a two-stage scrubber with a venturi first stage. The second stage, the scrubber, is an impingement tray absorber. Limestone slurry is the scrubbing agent. Various engineering problems were corrected, and in March 1973 the system passed the 500-hour test and consistently removes 90% of the sulfur from the flue gas at limestone-to-sulfur stoichiometric ratios of 1.08 to 1.5. The full-scale installation for St. Clair #6 is operational. Corrosion problems have been corrected, but the major problem remains to be sludge handling. (MCW)

17924 BLESSED BE THE MAN WHO BOUGHT GAS TURBINES. Marsh, W. D. Elec. Light Power, E/G Ed.; 52: No. 1, 28-29 (Jan 1974).

Evaluations are made concerning the use of supplemental gas turbines at a boiler-fired system. The decision to buy the gas turbine units may have been due to the availability of no other systems. Unexpected load demands, short lead times, and insufficient time for the installation of nuclear or fossil-fired plants are advantages discussed. Calculations are shown that the huge savings in capital costs associated with a gas turbine can buy hours and hours of burning even the most expensive fuel. The savings are compared with the basic operating advantage of fossil-steam and the operating cost disadvantage of gas turbines. Similar calculations are made for nuclear-steam units. (MCW)

17925 POWER/ENERGY: PROBLEMS AND PROGRESS. Friedlander, G. D. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 11: No. 1, 60-65 (Jan 1974).

The power industry will attempt to generate and deliver over two times the amount of power over the next ten years, but with diminishing supplies of fossil fuels and with the added concern of the environmentalists, massive changes in technology are required. A review is given of alternative methods being studied to alleviate the energy crunch. Construction data of reactors in the U. S. are tabulated. The fuel/energy equation for the U. S., Japan, and Western Europe, especially Germany, is discussed. (MCW)

17926 COOLING TOWER PRACTICES. Kolflat, T. D. Power Eng.; 78: No. 1, 32-39 (Jan 1974).

The United States accounts for 50% of the world cooling tower market and has been divided equally among the petrochemical industry, electric power generation, and comfort cooling. This is predicted to shortly become 25% petrochemical, 15% comfort cooling, and 60% electric power generation. In wet towers, water comes in intimate contact with the cooling air and transfers about 75% of the total heat by evaporation. Air-water contact occurs in the fill packing. Crossflow and counterflow describe wet towers with respect to the relative flow directions of the air and falling water in the fill. The dry type of cooling tower uses either air-cooled condensers or air-cooled heat exchangers, and there is no contact between air and water. The wet-dry tower has both wet fill and dry heat exchange surface. Towers are further classified by the method of creating air movement through them by mechanical draft, natural draft, or a combination of mechanical and natural draft. (MCW)

17927 DYNAMIC MODELING OF FOSSIL-FUELED PLANTS. Kwan, H. W. Power Eng.; 78: No. 1, 40-43 (Jan 1974).

Dynamic modeling for a 200-MW coal-fired, drum-type natural circulation boiler is described. The continuous maximum rating is 1,350,000 lb/h with steam conditions of 2450 psig and 568.3 C, reheating to 540.6 C at 457 psig. The economic rated output of the turbine is 200 MW at 3000 rpm. The unit is divided into the following lumped-parameters sections: economizer, drum, downcomer, waterfall, front wall radiant superheater, primary superheater, superheater spray attemperator, secondary superheater, high pressure turbine, reheater spray attemperator, horizontal reheater, pendant reheater, intermediate-pressure turbine, and low-pressure turbine. A simulator may be built using the model as the basis and used for training station operators. (MCW)

17928 PROGRESS REPORT ON SULFUR DIOXIDE. Grennard, A.; Ross, F. Combustion; 45: No. 7, 4-9 (Jan 1974).

The paths of sulfur dioxide are followed from emission to absorption and the effects along the way are described. The impact of sulfur dioxide on people, plants, soil, tree growth, rain and lakes, and in the air is discussed. The tall chimney is a dilution device, and data have shown that with sulfur emissions slowing increasing, there is a falling average concentration in the air that people breathe. (MCW)

17929 CONTROLLING EMISSIONS FROM FOSSIL-FUELED POWER PLANTS. Powell, E. M.; Ulmer, R. C. Combustion; 45: No. 7, 24-34 (Jan 1974).

Emission limits have been set on particulate, sulfur oxides, and nitrogen oxides. Tangentially fired units are currently being designed to meet current EPA NO_x emission standards. The technology of particulate removal by electrostatic collectors is well advanced, but the sulfur oxide is a prevailing problem. The control of sulfur oxide emissions was attained by fuel selection, but the abundance of low-sulfur fuels is diminishing. Some advances have been made on the preparation and treatment of coal and oil. Research continues on the production of clean fuel by gasification of coal. Solvent refining of coal permits both de-ashing and desulfurization of coal. The fluidized-bed combustion technique is discussed; lime can capture most of the sulfur oxides from the coal, and interest is shown in using the exhaust gases from the bed in combined-cycle applications. Combinations of gas turbines, steam generators (or heat recovery equipment), and steam turbines assembled for the reduction of plant cost or improvement of cycle efficiency in the utility power generation process are discussed. (MCW)

17930 METHOD AND APPARATUS FOR CONVERTING SOLAR RADIATION TO ELECTRICAL POWER. Glaser, P. E. (to Arthur D. Little, Inc.). US Patent 3,781,647. 25 Dec 1973. Filed date 26 Jul 1971. 14p.

Solar radiation is collected and converted to microwave energy by means maintained in outer space on a satellite system. The microwave energy is then transmitted to Earth and converted to electrical power for distribution. (Official Gazette)

17931 PRODUCTION OF FUEL GAS. Slater, W. L.; Schlinger, W. G.; Crouch, W. B. (to Texaco Inc.). US Patent 3,784,364. 8 Jan 1974. Filed date 4 Nov 1971. 6p.

Fuel gas suitable for use in conjunction with a gas turbine is prepared by subjecting a hydrocarbon oil to partial combustion using air as the oxidizing medium and injecting additional hydrocarbon oil into the hot partial combustion products. (Official Gazette)

17932 APPARATUS AND METHOD FOR GENERATING ELECTRICITY. Merrill, G. E. US Patent 3,784,449. 8 Jan 1974. Filed date 15 Mar 1971. 6p.

A turbine-driven high-frequency generator located in a chamber at the bottom of a deep hole in the Earth or on the ocean floor provides a natural head with respect to a turbine that is great enough to drive a generator that has a generating capacity sufficient to vaporize a substantial part of the water supplied to furnaces from the turbine. The steam produced in the furnaces is piped upward to a condenser, located at or near the surface, in which it is condensed into potable water and the water supplied to the turbine passes through the condenser to be preheated before dropping through the head to the turbine. (auth)

17933 PROCESS AND APPARATUS FOR OIL SHALE RETORTING. Frick, G. W. (to Cities Service Research and Development Co.). US Patent 3,784,462. 8 Jan 1974. Filed date 25 Feb 1971. 6p.

A process and apparatus are disclosed for the continuous steady state retorting of ground oil shale in the absence of air. Retorting is accomplished by countercurrently contacting heated spent oil shale with fresh ground oil shale in a vessel from which air is excluded. The spent oil shale is heated by combustion of its carbonaceous residue to form a hot heat transfer medium which, when contacted with fresh oil shale in the retorting process, provides the energy for the recovery of hydrocarbons. (auth)

17934 CATALYTIC CRACKING OF NAPTHA AND GAS OIL. Reynolds, D. L.; Youngblood, D. J.; Bunn, D. P. Jr.; Pratt, R. E. (to Texaco Inc.). US Patent 3,784,463. 8 Jan 1974. Filed date 2 Oct 1970. 18p.

Low-octane naphtha and fresh gas oil are catalytically cracked with a zeolite catalytic-cracking catalyst in separate elongated reaction zones yielding a naphtha having an increased octane rating. Recovering a naphtha fraction, particularly a heavy naphtha fraction, from the cracked product, and combining it with the fresh naphtha feed, further enhances the octane rating of the naphtha product. A cycle gas oil may be recovered from the reactor effluent and combined with the fresh naphtha feed and introduced into a separate (a third) elongated reaction zone to effect maximum recovery of naphtha and lighter stocks having improved product quality. Optionally, any of the feedstocks may be subjected to further cracking in a dense bed of the zeolite catalyst. (Official Gazette)

17935 TREATMENT OF GASES AND LIQUIDS. Nicklin, T.; Farrington, F. (to Gas Council). US Patent 3,784,465. 8 Jan 1974. Filed date 27 Jul 1972. 6p.

Gases or liquids are steam desulfided in the presence of a catalyst containing a uranium oxide together with a thorium oxide and/or a cobalt oxide. Air may also be present. The process is useful for desulfiding inorganic gases, for example, effluent gases, and for desulfiding organic compounds such as oils. (auth)

17936 GEOTHERMAL HOT WATER RECOVERY PROCESS AND SYSTEM. Kuwada, J. T. (to Rogers Engineering Co., Inc.). US Patent 3,782,468. 1 Jan 1974. Filed date 20 Sep 1971. 14p.

An improved process and system for recovering high-temperature hot water from a geothermal supply is described. Equipment is described for reducing the pressure at the well head, flashing the hot water to steam to elevate a two-phase mixture of steam and hot water through the casing assembly. Such flashing is accompanied by the evolution of substantially non-condensible gases, including carbon dioxide, and separated with the steam from the elevated hot water, the latter being withdrawn from the system for its intended use, such as the generation of electric power. The separated steam and gases are heat exchanged to condense the steam and to withdraw useful heat from the gases, and the gases are compressed and recycled into contact with the underground hot water supply to assist in elevating additional hot water. The carbon dioxide-containing gases are effective in countering the problems normally created when geothermal hot water is allowed to flash to steam, namely the formation of system clogging deposits. Thus, without utilizing mechanical or other pumping devices within the well, recovery of a substantially constant stream of geothermal hot water from a deep underground well may be effected. (MCW)

17937 RESTRICTIONS ON FUEL AVAILABILITY SERIOUSLY AFFECTING FUEL SELECTION OPTIONS. Gould, G. (Fuel Engineering Co., New York). Combustion; 45: No. 7, 20-23 (Jan 1974).

Shortage means there is not sufficient supply to meet demand. A crisis situation can occur either as a result of dynamic imbalances or as a result of exhaustion of finite resources. Fuel is destroyed in being used, and this crisis is a shortage as a result of dynamic imbalance. New reserves are not being found domestically to replace the energy sources being consumed each day in the U. S. For the reserves of natural gas currently available, the withdrawal rate on the annual basis is about one eleventh to one twelfth of the total reserve. For oil, the figure is about one eighth. In the area of conventional fuels, the options for maintaining a dynamic balance in the immediate future and probably in the mid-term are limited to supplementing supplies with supplies from foreign resources. At present, this option is hard to fulfill. Lead time on a nuclear power plant is about seven years; lead time for a pipeline quality coal gasification plant is seven years; and lead time for new developments at coal mines and oil refineries in three years. It is concluded that every Btu must be conserved and used efficiently. (MCW)

Information Handling

17938 (UCID-16354) EZQUERY. Holcomb, F.; Kroes, J.; Jessen, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Oct 1973. Contract W-7405-eng-48. 37p. Dep. NTIS $4.00.

EZQUERY is a generalized information retrieval and reporting system developed by the Data Processing Services Department to provide a method of accessing and displaying information from common types of data-base files. By eliminating the costs and delays associated with coding and debugging special purpose programs, it produces simple reports. It was designed with the user in mind, and may be used by programmers and nonprogrammers to access data base files and obtain reports in a reasonably brief period of time. (auth)

17939 (UCID-30082) COMBINE: A DATA BASE MANIPULATION CODE. Geertgens, C. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1973. Contract W-7405-eng-48. 12p. Dep. NTIS $3.00.

COMBINE is a computer code that generates the data base for the data reduction code DYMEC 17 used at LLL. Five data acquisition systems located at remote locations in the Laboratory use DYMEC 17. Data from the five acquisition systems are in three different formats: DYMEC, CDC 1700, and mini-computer. (auth)

Law

Refer also to abstracts 15939, 15977, and 16419.

17940 PROTECTION OF THE POPULATION IN THE ITALIAN REGULATIONS AND IN INTERNATIONAL STANDARDS. Marchetti, D. (Capo Ufficio Legislativo Ministero Industria, Rome). pp 197-205 of Nuclear Energy and the Environment. Rome; Comitato Nazionale Energia Nucleare (1973). (In Italian).

From proceedings of the 17th nuclear congress; Rome, Italy (23 Mar 1972). See CONF-720356-.

The basic Italian nuclear legislation is the law of December 31, 1962, No. 1860, on the peaceful use of nuclear energy and the Presidential decree of February 13, 1964, No. 185, on the safety of the plant and the health protection of workers and the population against ionizing radiation. The provisions of these two documents are summarized. (JSR)

17941 LAW CONCERNING AGREEMENT NO. 115 OF THE INTERNATIONAL LABOUR ORGANIZATION OF JUNE 22, 1960 ON THE PROTECTION OF WORKERS AGAINST IONIZING RADIATIONS. Bundesgesundheitsblatt; No. 37, 933-939(1973). (In German, English, and French).

The full text of the agreement is in English, French, and German. (GE)

17942 PROBLEMS CONCERNING THE REVISION OF THE PARIS CONVENTION ON THE THIRD PARTY LIABILITY IN THE FIELD OF NUCLEAR ENERGY. Marchetti, D. (Ministero dell'Industria, Commercio e Artigianato, Rome). (1973). vp.

From 1st international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The essential problems connected with a conference to revise the Paris Convention are dealt with. The author expresses the opinion that this conference is not necessary either from the

norm standpoint in Art 22 (c) of the Convention itself or as regarding its short time span. (GE)

Management

17943 (AECL-1027(7th Ed.)) HEALTH AND SAFETY ORGANIZATION. Seventh Edition. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1973. 52p. AECL Free.

A summary is presented of the provisions for health and safety, in particular radiation safety, at Atomic Energy of Canada Limited. Topics discussed include the derivation of legal authority, establishment of policy, assignment of operational responsibility, and provision of expert advice for management. (auth)

17944 (LA-UR-73-1428) PRINCIPLES OF SAFETY. Safety in General, Criticality Risk in Perspective. Reider, R. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 21p. (CONF-731056-1). Dep. NTIS $3.25.

From safety seminar; Miamisburg, Ohio, USA (29 Oct 1973).

The role of management in the responsibility for training personnel in the fundamentals of safety and accident prevention is discussed. Programs for radiation protection, with emphasis on criticality safety, are discussed briefly. (CH)

17945 (NP-19909) OECD NUCLEAR ENERGY AGENCY FIRST ACTIVITY REPORT. (Organization for Economic Cooperation and Development, Paris (France)). 1972. 79p. Dep. NTIS (U. S. Sales Only) $6.00.

The First Activity Report of the NEA covers such matters as radiological protection, safety of nuclear installations, radioactive waste management and disposal, and the basic legal and administrative framework that the solution of problems in these fields implies. An analysis is made of the contributions that nuclear power is making now, and is expected to make to meet energy demand in the OECD area. Work continues on two experimental reactor projects, Halden and Dragon. Interest is maintained for the development of gas-cooled fast reactor technology; research on methods for the treatment and storage of highly radioactive reprocessing wastes; application of radioisotopes in medical applications and as irradiation sources for food preservation; direct energy conversion by MHD and thermionic systems; and the work of a specialized committee on the collection, classification, evaluations, and diffusion of scientific and technical information. NEA has operated the Neutron Data Compilation Centre (CCDN) at Saclay and the Computer Program Library (CPL) at Ispra for nearly 10 years. (MCW)

17946 QUESTIONNAIRE INQUIRY ON THE USE OF EXTERNAL PERSONNEL MONITORS IN JAPAN. Hoken Butsuri; 8: No. 3, 167-171(Sep 1973). (In Japanese).

The questionnaire inquiry was carried out on the use of personnel monitors for external radiations in Japan. A total of 400 institutions (including 71 universities, 9 electric power plants, 3 nuclear fuel companies, 13 non-destructive inspection companies, 58 industrial institutes, 36 national and public institutes, 94 hospitals, 29 pharmaceutical facilities, and others) were selected to send the questionnaires, and 179 (45%) were answered and returned. Approximately 70% of the establishments replying had less than 50 employees. Film badges (FB) were used in about 90% institutions as a personnel dosimeter, TLD's in 13%, and fluoroglass dosimeters (FGD) in 6%. About 20% indicated the possibility of using FGD for personnel monitors in the future in lieu of FB, while 45% suggested TLD. The users' requests for the improvement of monitors were; (1) measurement of lower dose level (54%), (2) less expensive monitors (48%), (3) higher accuracy for low energy x, γ (37%), (4) monitors for detecting spot exposure (32%), (5) more uniform quality (30%), (6) higher accuracy for β-dose evaluation (30%), (7) improvement of reproducibility (29%), (8) improvement of mechanical strength (20%), (9) higher accuracy for neutron dose evaluation (12%), and (10) higher accuracy for high energy x, γ (8%). (auth)

Mathematics and Computers

Refer also to abstract 17939.

17947 (BNL-18222) USA/CANADA DECUS DECSYSTEM-10 ACTIVITIES. Kropp, W. H. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 3p. (CONF-730948-1). Dep. NTIS $3.00.

From USA/Canada DECUS meeting; London, UK (11 Sep 1973).

It has been approximately four years since the inception of the USA/CANADA DECUS DECsystem-10 Mainframe and its separation from the minicomputers. A reorganization of the DECsystem-10 Mainframe into a formal structure is a direct result of the following: (1) the need for effective communications within the DECsystem-10 LUGs, (2) the need for effective planning to define the direction of the DECUS DECsystem-10 organization, (3) the need to coordinate the activities of the DECUS DECsystem-10 organization with DEC, and (4) the broadening in scope and duration of the symposia. Some of the activities of the USA/CANADA DECUS DECsystem-10 Mainframe are reviewed. (auth)

17948 (BNWL-1795) MICROPROCESSOR SAMPLED DATA PROCESS CONTROLLER. Seim, T. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1973. Contract AT (45-1)-1830. 117p. Dep. NTIS $5.45.

A micro-miniaturized digital processor was utilized in the development of a sampled data process controller. While general purpose in nature, the processor was applied specifically to control temperature. Physically, the processor was found to be well suited for industrial environments, as its relatively slow speed and high switching voltage levels made it exceptionally noise immune. Successful application was found to be more dependent on external software development support than anything else. This is because of the very limited nature of the processor in terms of memory and input-output peripherals. (auth)

17949 (COO-2118-46) DESIGN OF AN ALGORITHM FOR THE DISPLAY OF VISIBLE SURFACES. Donovan, W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Oct 1973. Contract AT(11-1)-2118. 61p. (UIUCDCS-R-73-592). Dep. NTIS $5.25.

Thesis.

A visible surface algorithm capable of showing on a raster display smooth, transparent objects without jagged edges is described. The polygons defining the object to be displayed are put into visible order, and then output to the raster frame buffer by a special face drawing and shading algorithm. Very large objects or collections of objects can be manually put into visible order and each group drawn separately; this allows scenes with more faces than can be held in the program data structure at any one time. Minimum hardware for implementation is a raster display with a frame buffer, and a minicomputer with a disk. (auth)

17950 (COO-2118-48) COMPUTER METHODS FOR ANALYSIS AND SYNTHESIS OF VISUAL TEXTURE. Jayaramamurthy, S. N. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Sep 1973. Contract AT(11-1)-2118. 137p. (UIUCDCS-R-73-601). Dep. NTIS $9.00.

Computer methods are presented which deal with the problems of visual texture, specifically Texture Analysis and Texture Synthesis. The Decision Theory Method, as its name indicates, is based on the principles of statistical decision theory. This method in conjunction with the Internal Covering Theory, automatically generates a set of interval complexes which act as 2-D filters that detect texture features in the scene of analysis. The versatility of this method to deal with various problems of visual texture, such as scene segmentation using textural information, extraction of texture borders, discrimination/recognition of both spatially and chromatically textured scenes, etc. is demonstrated. A model is proposed that views the pixels of a digitized textural scene as a two-way seasonal time series. Based on this model, a method is developed for synthesis of natural looking textures. This method possesses a desirable quality that the parameters needed for the synthesis are derived from the analysis of "parent" texture, i.e., the texture to be imitated. Extending the concepts of two-dimensional formal grammars, known as array grammars, "multilevel array grammars" are introduced. These are shown capable of generating complex texture scenes, specifically "brick-wall-type" texture, that is, those textures which are perceived at many levels and at each level, they can be either structural or statistical. A way of specifying these grammars for texture scenes in real cases, with the help of "interval complexes," is also indicated. (96 references) (auth)

17951 (KFK-1885) DISPLAY: A TSO COMMAND PROCESSOR FOR FAST OUTPUT OF ALPHANUMERIC DATA ON A KFK STORAGE TUBE. Strolz, W. (Kernforschungszentrum Karlsruhe (F.R. Germany)). Nov 1973. 81p. (In German). Dep. NTIS (U.S. Sales Only) $6.25.

At the Karlsruhe Nuclear Research Center storage tube displays are attached to the computing system IBM 360/65. They are used under the Time Sharing Option (TSO) of the Operating System 360 as fast output devices for alphanumeric data. The displays are allocated to the TSO Foreground Jobs by means of symbolic parameters. Data output is initialized by the new TSO command DISPLAY. Function and syntax of the command and the internal structure of the command processor are described. (auth)

17952 (LA-5463-MS) TABLES OF SOLUTIONS OF THE DIOPHANTINE EQUATION $x^3 + y^3 = z^3 - d$. Gardiner, V. L., Lazarus, R. B.; Stein, P. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 67p. Dep. NTIS $5.45.

This report tabulates all primitive integer solutions of the (analytically intractable) diophantine equation $x^3 + y^3 = z^3 - d$, $|d|$ not a cube, over a wide range of values of x, y, z. The interest in studying the solutions derives from the so-called "Easier Waring Problem." The results of the present study–completed more than 10 years ago–are negative in the sense that they do not tend to confirm the conjecture. Of course, nothing definitive can be said on the basis of such limited calculations. The principal results are (a) for $0 < |d| \leq 999$ (and, of course, $d \not\equiv 4, 5 \pmod 9$) there are 70 values of $|d|$ for which no solutions exist (the smallest case is $|d| = 30$); (b) no new parametric families of solutions (such as exist for $d = 2$, $d = 128$) were discovered; (c) no new solutions were found for $|d| = 3$. (auth)

17953 (ORNL-TM-4404) USER'S MANUAL FOR MODSOV, A TERMINAL OPERATED PROGRAM SOLVING THE LINEAR MATRIX EQUATION $\dot{x} = Ax + k$. Clark, F. H.; Booth, R. S.; Vanderploeg, H. A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 41p. Dep. NTIS $4.25.

To meet day-to-day calculation requirements of ecological systems, the linear matrix equation $\dot{x} = Ax + k$ was programmed for terminal operation. The existing program MATEXP, which deals with this problem class, was adapted to the task. A simple conversational structure was created to enable use of the program with only a few minutes of training. The user can designate a specific activity or a radioactivity model, thereby causing the program to undertake some of the coefficient processing from minimal input. Or, he may choose to solve a more general problem and supply all coefficients explicitly. A unique feature of the program is an option which permits the user to suppress short-time characteristics after they have no more appreciable effect on the solutions. This option enables avoidance of the most often encountered form of mathematical instability for this class of problems. (auth)

17954 (RFP-Trans-142) DIGITAL-FREQUENCY METHOD. Nyblom, A.; Ulen, E. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Translation of FOA-2-A-2432-234. 74p. Dep. NTIS $5.75.

For less-complex TN systems (for example, surface missiles with short span) analog computing units are usually used. However, a digital computing unit gives great advantages as it is then possible to perform precise integrations free from deviation. In many cases an incremental-type computing unit is suitable. A method is described that uses binary numbers and pulse frequencies. The method is called the digital-frequency method. It may possibly be used even in controlling minor processes of other types. (auth)

17955 (SLA-73-967) BYTE-MANIPULATION SUBROUTINES FOR THE PDP-10 COMPUTER. Jones, M. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 14p. Dep. NTIS $3.00.

A group of five FORTRAN-callable subroutines is presented. These allow manipulation of bytes of any size (up to 36 bits or a full word), from any location within a source variable to any location within a target variable. A single call moves any number of bytes of a given size; alternatively, repeated calls fetch or store adjacent bytes successively without bookkeeping effort on the part of the user. Code is in MACRO-10 assembly language. Examples are given illustrating the use of the calls. (auth)

17956 (SLA-73-1060) SOLVING ORDINARY DIFFERENTIAL EQUATIONS WITH ODE, STEP, AND INTRP. Shampine, L. F.; Gordon, M. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 26p. Dep. NTIS $3.50.

This document shows by example how to solve ordinary differential equations with subroutines ODE, STEP and INTRP. ODE is intended for routine problems, STEP and INTRP for problems with special requirements. (auth)

17957 (SLA-73-7033) SURVEY OF REVISIONS AND EXTENSIONS TO AMERICAN NATIONAL STANDARD FORTRAN X3.9-1966. Initially Approved by ANSC X3J3. Bailey, C. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 16p. (CONF-731206-1). Dep. NTIS $3.00.

From applied mathematics division seminar; Argonne, Illinois, USA (13 Dec 1973).

Brief discussions are given for the following: character data, DO and implied DO, format field descriptors and formatted conversion, input/output list, new read/write capabilities, and input/output concepts. (MOW)

17958 (SU-326-P-30-29) SOLUTION OF SPARSE INDEFINITE SYSTEMS OF EQUATIONS AND LEAST SQUARES PROBLEMS. Paige, C. C.; Saunders, M. A. (Stanford Univ., Calif. (USA). Dept. of Computer Science). Nov 1973. Contract AT(04-3)-326. 49p. (STAN-CS-73-399). Dep. NTIS $4.50.

The method of conjugate gradients for solving systems of linear equations with a symmetric positive definite matrix A is given as a logical development of the Lanczos algorithm for tridiagonalizing A. This approach suggests numerical algorithms for solving such systems when A is symmetric but indefinite. The new methods can be applied to linear least squares problems with or without constraints, with simplifications when there are no constraints. These methods have advantages when A is large and sparse. Fortran subroutines are included. (auth)

17959 (UCRL-13586) APPLICATION OF LINEAR TRANSFORMS AND ESTIMATION THEORY TO THE ANALYSIS OF CHEMICAL DATA. Final Report. Brubaker, T. A. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). 15 Aug 1973. Subcontract 8032409. 119p. Dep. NTIS $8.00.

For California Univ., Livermore. Lawrence Livermore Lab.

Results from work performed from July 1, 1972 through June 30, 1973 are described. Specific tasks undertaken were: (1) continued investigation of linear transforms for use with chemistry data; (2) investigation of Kalman filtering for the analysis of chemistry data; (3) simulation methods for evaluation of chemistry systems; and (4) teaching of three 1-week short courses on signal theory to chemistry department personnel. Four separate reports were written and are included as appendices. (auth)

17960 (UCRL-74795) INFLUENCE OF MACHINE ORGANIZATION ON ALGORITHMS. Owens, J. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1973. 12p. (CONF-730579-1). Dep. NTIS $3.00.

From symposium on complexity of sequential and parallel numerical algorithms; Pittsburgh, Pennsylvania, USA (16 May 1973).

A comparative analysis of the CDC STAR-100 and the ILLIAC IV for a given code is given. A large two-dimensional Lagrangian hydrodynamic model for the STAR-100 computer was programmed. Some theoretical considerations concerning execution rates are presented. Some examples are given of where these theoretical considerations were important considerations in the design of the algorithms. Finally, several observations and opinions, many of which may be controversial but which should be considered by the programming world at large, are described. (MOW)

Miscellaneous

17961 (AECL-4608) FORSIM: A FORTRAN-ORIENTED SIMULATION PACKAGE FOR THE AUTOMATED SOLUTION OF PARTIAL AND ORDINARY DIFFERENTIAL EQUATION SYSTEMS. Carver, M. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75. AECL $1.00.

The FORSIM program is a versatile general package for the solution of partial and/or ordinary differential equation systems. The program has been in use as an ordinary differential equation package for some time, both at Atomic Energy of Canada Limited and at several other institutions and an adequate user's manual (AECL-4311) already exists for this application. The program is now extended to provide automatic solution of a variety of linear and nonlinear partial differential equations. The partial differential equations are converted into a set of coupled ordinary differential equations, which are then integrated in time using an error controlled variable step integration algorithm. The equations, initial conditions and any special instructions are specified by the user in a single FORTRAN subroutine. This is then loaded with the control routines which perform the solution and any necessary input or output. A description of the application of the FORSIM system to partial differential equations, instructions for its use, and several illustrative examples are given. A more detailed description of the philosophy and content of the FORSIM system has been given in Atomic Energy of Canada Limited report AECL-4311. (auth)

17962 (CONF-710230-1) METHOD FOR THE EVALUATION AND CERTIFICATION OF SUPERMICROMETERS. Lane, D. L.; Cushing, L. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Jan 1971. 14p. Dep. NTIS $3.00.

From IMOG meeting; Livermore, California, USA (3 Feb 1971).

A laser-interferometer method is used for checking the accuracy of a supermicrometer, or just the accuracy of its lead screw and nut. The micrometer holding fixture was designed as a portable unit to accommodate several different makes of supermicrometers. The positioning of the laser interferometer is described. The micrometer can be checked from any point to any other point by setting a known value and reading the actual displacement from the interferometer digital readout. (MCW)

17963 (COO-1574-37) PROPERTIES OF RARE-GAS SOLIDS. Progress Report for Period Ending February 28, 1974. Pollack, G. L. (Michigan State Univ., East Lansing (USA)). 1974. Contract AT(11-1)-1574. 17p. Dep. NTIS $3.00.

The studies included: superfluid He film flow into and out of solid Ar beakers, Kapitza resistance, thermal conductivity of solid Ar and other molecular solids, and interactions of rare gases with biological materials. (DLC)

17964 (COO-3403-8) ROTATIONAL ORDERING IN THE SOLID MOLECULAR HYDROGENS. Progress Report No. 8, November 1, 1972–October 30, 1973. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). 1973. 33p. Dep. NTIS $3.75.

Nuclear spin–lattice relaxation measurements were made in solid mixtures of ortho- and para-deuterium. (DLC)

17965 (EDFB-IBP-73-8) ENERGY FLOW AND NUTRIENT CYCLING IN A CRYPTOZOAN FOOD-WEB. McBrayer, J. F.; Reichle, D. E.; Witkamp, M. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 78p. Dep. NTIS $5.45.

Thesis. Submitted by J. F. McBrayer to Univ. of Tennessee, Knoxville.

A model for energy flow through a forest-floor arthropod system is developed and used to estimate fluxes of eight elements through the decomposer food-web. Field estimates of standing crops of undecomposed leaves and stems and partially decomposed litter were made at monthly intervals for one year. Forest floor invertebrates were sampled concurrently and separated according to four consumer levels: (1) fungivores, (2) litter grazers, (3) general detritivores, and (4) predators. Estimates of microbial standing crops and productivities were obtained from related studies in the same community for inclusion in the food-web model. (LMT)

17966 (LA-5464-MS) DEGENERACIES OF VIBRATION–ROTATION LEVELS IN CERTAIN OCTAHEDRAL MOLECULES. Cantrell, C. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

The degeneracies of the vibration-rotation levels of octahedral AB_6 molecules are calculated for the case in which the B nuclei are identical fermions of spin 1/2. (auth)

17967 (LBL-2331) FOUR FUNCTION CALCULATOR USED TO AUTOMATICALLY COMPUTE WAVELENGTH. Nakamura, M.; Shalimoff, G. V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 17p. Dep. NTIS $4.00.

An inexpensive four function calculator is being used to calculate the wavelength of spectral lines on photographic plates measured with an optical comparator. The computations are made repetitively from the digitized screw position of the optical comparator in 0.8 seconds. The duration of the displayed wavelength is variable from 0.3 to 3 seconds. Although our system already has a semi-automatic card punch system for processing data via a computer, the instantaneous calculation and presentation of wavelengths of spectral lines is of great value. (auth)

17968 (NASA-SP-5964(1)) ELECTRONIC CONTROL CIRCUITS. A Compilation. (National Aeronautics and Space Administration, Washington, D. C. (USA)). [nd]. 23p. NTIS.

17969 (ORO-3992-159) EXISTENCE OF THE STEADY STATE IN THE STOCHASTIC VOLTERRA MODEL. Reddy, V. T. N. (Texas Univ., Austin (USA). Center for Particle Theory). [nd]. Contract AT(40-1)-3992. 4p. (CPT-203). Dep. NTIS $3.00.

It is proven that with the previous birth and death terms, the stochastic model corresponding to the Volterra equation for a prey-predator system does not have a steady state distribution of probabilities in which both the prey and the predator are not extinct. (JFP)

17970 (SLA-73-835) THERMOCOMPRESSION BONDING CAPABILITIES OF METALLIZED TERMINATIONS ON DISCRETE COMPONENTS. Chavez, E. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 28p. Dep. NTIS $3.50.

The procedures and processes used to define the wire-bonding capabilities of metallized end terminations on discrete components are described. Included are the procedures that were used to determine the thermocompression bonding capabilities as well as the processes which were utilized to enhance bondability. This report describes the general characterization of the bonding equipment, the bonding-temperature considerations required to develop a suitable bond schedule, and the optimized bonding parameters for the passive devices evaluated for this study. Results demonstrated the capability of metallized terminations to satisfactorily accept ball bonds after subsequent metallization conditioning, and utilizing thermocompression techniques at reduced bonding temperatures. (auth)

17971 (UCRL-51459) STUDIES OF POLLUTANT CONCENTRATION FREQUENCY DISTRIBUTIONS. Pollack, R. I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Oct 1973. Contract W-7405-eng-48. 96p. Dep. NTIS $5.45.

Thesis. Submitted to Polytechnic Inst. of Brooklyn, N. Y.

A model is presented which binds together previous theoretical and empirical findings in a unified framework, and in so doing provides a deeper understanding of the physical processes which affect frequency distributions of air pollutant concentrations. The frequency distributions of air pollutant concentrations have been derived from first principles for both point and area sources, for both reactive and inert pollutants. (auth)

17972 TEMPERATURE OF LASER PLASMA. Arifov, U. A.; Bedilov, M. R.; Tsoi, T. G.; Kuramatov, D.; Beisenbaeva, Kh. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 5, 19-21(1973). (In Russian).

The energy spectra of ions of laser plasmas were investigated by the time-of-flight of the charged particles. The spectra were determined in dependence on the nature of the target and the pressure of the residual gas in the chamber. The average temperature of the plasma was also determined. Targets of Al, Ti, Mo, Cu, Cd, Ta, and W were used. On the basis of the spectral investigation it was assumed that the laser plasma consists basically of singly charged ions. (JSR)

Chemistry

17973 (ANL-TRANS-948) APPLICATION OF EXCHANGE REACTIONS FOR THE MULTIPLICATION OF SULFIDE AND SULFATE. Weisz, H.; Fritsche, U. Translated from Mikrochim. Acta; No. 3, 638-643(1970). 8p. Dep. NTIS $3.00.

Iodometric methods are given for the determination of milligram quantities of sulfide (exchange reaction with silver iodide) and microgram amounts of sulfate (exchange reaction with barium iodate in a medium containing acetonitrile). (DLC)

17974 (CONF-731052-1) FORMATION OF NITROSAMINES FROM TERTIARY AMINES AND NITROUS ACID. Lijinsky, W.; Singer, G. (Oak Ridge National Lab., Tenn. (USA)). 1973. 10p. Dep. NTIS $3.00.

From 3rd meeting on analysis and formation of ni-nitroso compounds; Lyon, France (17 Oct 1973).

It is concluded that tertiary amines react quite readily with nitrous acid at moderately acid pH (3-6) to form nitrosamines, that such reactions take place significantly at body temperature, and that the large aliphatic tertiary amines give higher yields than do the short chain compounds. A continuation of the authors' earlier studies with drugs (Lijinsky, et al., Nature, 239: 165-7 (1972)) illustrates the possible significance of some of the reactions in man, when food-containing nitrite is eaten. However, the large variation in the amount of nitrosamine formed from the compounds of different chemical structure demonstrates the difficulty of estimating the magnitude of the hazard presented by any one compound. (DLC)

17975 (KFKI-73-60) ROTATIONAL DIFFUSION OF PARA-AZOXY-ANISOLE MOLECULES IN LIQUID CRYSTAL AND ISOTROPIC LIQUID STATE. Bata, L.; Vizi, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

17976 (LA-5467-PR) DEVELOPMENT OF A MULTISTAGE TANDEM AIR SAMPLER FOR MERCURY. LASL Project R-060. Quarterly Report, April 1–September 30, 1973. Campbell, E. E.; Trujillo, P. E.; Wood, G. O. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

The thermal desorption of organic mercurials from sampling tubes containing Carbosieve B was studied. The techniques used in the desorption and determination of metallic mercury collected on silvered Chromosorb P were also found applicable for determining organic mercurials collected on Carbosieve B. The retention and removal of metallic mercury vapor from Carbosieve B was also investigated. Under the experimental conditions, the retention of metallic mercury by Carbosieve B was less than 2% of the total mercury that passed through the Carbosieve B if the Carbosieve B was purged with nitrogen gas before analysis. A study was made to extend the upper range of the thermal desorption–flameless atomic absorption technique for mercury analysis. The study included shortening the optical light path, different instrumental configurations, and electronic desensitizing. A dual cell system (2 cm and 15.5 cm) made from two MAS-50 Mercury Analysis Systems was found to be the most flexible. The pressure drops of newly designed mercury sampling tubes for sampling both organic and metallic mercury vapors were measured. These tubes meet the criteria established by NIOSH for the personal sampling system. A tentative method for determining organic mercurial and metallic vapors was written and presented to NIOSH. (auth)

17977 (UCRL-7873(Pt. 4)) SOME ANALYTICAL METHODS FOR EXPLOSIVES AND EXPLOSIVE SIMULANTS, PART IV. Selig, W. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1973. Contract W-7405-eng-48. 57p. Dep. NTIS $5.45.

A collection of methods suitable for routine performance by technicians for analyzing explosives and explosive simulants is presented. The techniques employed include various forms of chromatography, serial extraction, and nonaqueous titration. (auth)

Life Sciences

17978 (BNL-18364) PROGRESS IN DESIGNING SMALL INHIBITORS WHICH DISCRIMINATE AMONG TRYPSIN-LIKE ENZYMES. Shaw, E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 25p. (CONF-731055-1). Dep. NTIS $3.25.

From fifth international symposium on proteinase inhibitors; Grosse Ledder, F. R. Germany (17 Oct 1973).

Earlier work on the affinity labeling of trypsin was extended in the direction of obtaining more selective agents. The choice of trypsin-like target enzymes was somewhat arbitrarily made, but a number of reagents were devised that can discriminate between individuals of a pair of trypsin-like enzymes. In one case, nitrophenyl p-amidinophenylmethanesulfonate, even more remarkable selectivity was obtained. It is concluded that, although trypsin-like enzymes may all be homologous and therefore possess very similar active centers, apparently reactivity differences exist that offer a basis for selective inactivation by small molecule inhibitors. (8 figures, 23 references) (auth)

17979 (CONF-731045-1) EXPERIMENTAL APPROACHES TO THE IDENTIFICATION OF CARCINOGENIC AIR CONTAMINANTS. Nettesheim, P. (Oak Ridge National Lab., Tenn. (USA)). 1973. 8p. Dep. NTIS $3.00.

From 4th conference on environmental toxicology; Fairborn, Ohio, USA (16 Oct 1973).

Various experimental approaches for testing the carcinogenicity of various air contaminants are described. The essential considerations in selecting the experimental model for specific research objectives, as well as the advantages and limitations of the different animal models currently used in respiratory-tract carcinogenesis studies, are discussed. (auth)

17980 (CONF-731125-1) BALANCE OF HOST IMMUNOCOMPETENCE IN CHEMICAL CARCINOGENESIS AND NONSPECIFIC IMMUNOTHERAPY. Hanna, M. G. Jr.; Szakal, A. K.; Peters, L. C. (Onk Ridge National Lab., Tenn. (USA)). 1973. 49p. Dep. NTIS $4.50.

From symposium on special problems of cancer chemotherapy; Dusseldorf, F. R. Germany (9 Nov 1973).

Data are reviewed from studies on the ability of antigenic tumors to develop and the nature of the immune status of the host against its own primary tumor. Results of studies on guinea pigs are reported. (CH)

17981 (COO-3278-16) GROWTH AND DISSIPATION OF PHYTOPLANKTON IN CHESAPEAKE BAY. II. A Statistical Analysis of Phytoplankton Standing Crops in the Rhode and West Rivers and an Adjacent Section of the Chesapeake Bay. Seliger, H. H.; Loftus, M. E. (Johns Hopkins Univ., Baltimore, Md. (USA). McCollum-Pratt Inst.). 1973. Contract AT(11-1)-3278. 82p. Dep. NTIS $6.25.

17982 (LA-5460-PR) HIGH-SPEED PHYSICAL METHODS FOR DETECTING TRICHINELLAE IN MEAT. Annual Report, July 1, 1972-June 30, 1973. Holm, D. M.; Giles, P. M.; Seagrave, J. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

Two improved methods that permit rapid detection of trichinellae infesting pork are described. The projection method uses a pressed and clarified thin sample of the meat as a projection transparency, and the digestion method is a highly accelerated version of the classical digestion method. Both methods can be performed in less than 5 man-min/sample when done manually on 1-g samples. A few larvae/gram can be detected with high probability. (auth)

17983 (LA-5461-PR) ENZYME-LABELED ANTIBODY ACTIVITIES. Annual Report, July 1, 1972-June 30, 1973. Saunders, G. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

An indirect enzyme-labeled antibody (ELA) test has been developed for the screening of swine for hog cholera antibodies. The suspect sera are incubated with disks coated with hog cholera antigen. Following washing of the disks, they are then incubated with horseradish peroxidase-labeled antiswine gamma globulin. Enzyme substrate is then provided, and positive disks become quite dark due to deposition of large amounts of the reaction product. Swine sera samples (164) were screened, and 160 of them agreed with results obtained previously using the serum neutralization (SN) test. There were 4 apparent false positives by ELA. The ELA screening procedure is rapid, simple to perform, and should be applicable to other animal and human diseases. (auth)

17984 (LA-UR-73-1688) ELECTRONIC ANIMAL IDENTIFICATION AND TEMPERATURE MONITORING. Baldwin, H. A.; Depp, S. W.; Koelle, A. R.; Freyman, R. W. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 26p. (CONF-731053-1). Dep. NTIS $3.50.

From 77th annual meeting of the U. S. Animal Health Association; St. Louis, Missouri, USA (18 Oct 1973).

A unique system of identifying animals so that a computer-compatible digital code number can be automatically recognized by electronic methods is described. The transponder attached to the animal is passive and has an unlimited life. It provides a means of measuring body temperature in animals in addition to providing identity. The characteristics of the system and its potential in animal health control are discussed. (25 figures) (auth)

17985 (ORNL-4920) MOLECULAR ANATOMY (MAN) PROGRAM. Semiannual Progress Report, March 1, 1973-August 31, 1973. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 139p.

Separate abstracts were prepared for each of the five sections of the report. (MCG)

For abstracts of individual sections see: 17986-17990.

17986 (ORNL-4920, pp 1-30) CANCER. Dec 1973.

In Molecular Anatomy (MAN) Program.

Progress is reported on research on basic biological and immunological properties of fetal antigens in anticipation of using these antigens as tools for early detection of neoplastic transformation. Correlations of data from the MAN program study of fetal antigens with other research reports are presented. Data on the following research projects are presented: humoral and cellular immunity to fetal antigens; relationship of fetal antigen to tumor-specific transplantation antigen; relationship of fetal antigens to other antigens; materno-fetal relationships and tumor immunology; and capacity of fetal antigens to prevent spontaneous leukemia in mice. X-irradiated fetuses and tumor cells were used in some studies and radioimmunoassay was used in determining antibodies. (HLW)

17987 (ORNL-4920, pp 31-35) INFECTIOUS DISEASES. Dec 1973.

In Molecular Anatomy (MAN) Program.

Studies on infectious diseases include development of a method for producing a purified and stable inactivated trivalent parainfluenza vaccine suitable for use in human clinical trials; assay of guinea pig antiserum to glycoprotein of respiratory syncytial virus for antibodies; DNA polymerase activity in hepatitis B antigen; and radioimmunoassay of Dane particles of hepatitis B antigen. (HLW)

17988 (ORNL-4920, pp 37-93) BIOTECHNOLOGY. Dec 1973.

In Molecular Anatomy (MAN) Program.

Progress is reported on the development of (1) fast analytical systems for rapid parallel analysis of large numbers of body fluid samples, and (2) automated high-resolution analytical systems for analysis of body and tissue fluids for molecular constituents. (15 figures) (DLC)

17989 (ORNL-4920, pp.95-108) MEDICAL INSTRUMENTATION. Dec 1973.

In Molecular Anatomy (MAN) Program.

A synthetic ^{67}Ga γ-ray image was produced which resembles a patient with Hodgkin's disease. It was used to test the antiscatter and antipenetration processing. (DLC)

17990 (ORNL-4920, pp 109-124) ASSOCIATED RESEARCH AND DEVELOPMENT. Dec 1973.

In Molecular Anatomy (MAN) Program.

Progress is reported on the following research projects: immunotechnology; blood cell separators for in vivo leukapheresis; heterogeneity of carcinoembryonic antigen; functional organelles in procaryotes; and electron microscopy of the carboxysomes of Thiobacillus neapolitanus. (HLW)

17991 (ORNL-tr-2776) EFFECT OF PREY BEHAVIOR ON METHOD OF HUNTING AND FOOD COMPOSITION OF PREDATOR. Ivanova, M. N. Translated by M. Gerrard from Biol. Vnutr. Vod, Inform. Byull.; No. 5, 52-56(1970). 4p. Dep. NTIS $3.00.

17992 (RLO-2225-5-18) BIBLIOGRAPHY OF THEORETICAL POPULATION GENETICS. Felsenstein, J.; Taylor, B. (eds.). (Washington Univ., Seattle (USA). Dept. of Genetics). [nd]. Contract AT(45-1)-2225. 454p. Dep. NTIS $10.60.

A list is presented of 3,749 references to scientific papers, abstracts, books, technical reports, and theses on genetics of

animals and plants, including the related areas of statistical human genetics and quantitative genetics. (CH)

17993 (RT/BIO-(73)7) GENETIC CONTROL OF THE ERYTHROID DIFFERENTIATION IN RAT EMBRYOS. Andreozzi, U.; Fantoni, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1971. 40p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.00.

17994 (SGAE-2163) PURINE SALVAGE IN SPLEEN CELLS. Partsch, G.; Altmann, H.; Eberl, R. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Sep 1973. 13p. (CONF-730674-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international symposium on purine metabolism in man; Tel Aviv, Israel (17 Jun 1973).

Purine salvage pathways were studied in spleen cell homogenates of Swiss mice using an in vitro system with ^{14}C-labeled purine bases. The results indicate that a high purine-PRT activity exists in these cells. Guanine-PRT shows the highest activity followed by hypoxanthine-PRT and adenine-PRT. Besides the direct conversion of purine bases to nucleosides two other salvage pathways were detected in these cells. In these cases purine bases react first with ribose-1-phosphate or deoxyribose-1-phosphate forming a purine nucleoside or purine deoxynucleoside, which is further phosphorylated to nucleotides. In contrast to purine-PRT the enzyme activities are low. (auth)

17995 (UCRL-75232) HIGH-SPEED CELL ANALYSIS AND SORTING WITH FLOW SYSTEMS: BIOLOGICAL APPLICATIONS AND NEW APPROACHES. Van Dilla, M. A.; Steinmetz, L. L.; Davis, D. T.; Calvert, R. N.; Gray, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Nov 1973. 16p. (CONF-731112-20). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A brief historical account of cell analysis and sorting by high-speed flow-through methods is presented. The status of the Lawrence Livermore Laboratory program in this area is described, including biological applications such as the measurement of the DNA content of mouse liver cells and cultured mammalian cells. Histograms of cellular DNA content can be analyzed mathematically by means of a least-squares fitting code. The usefulness of this procedure in extracting information on the life-cycle parameters of growing cells is demonstrated. A simple computer model of cell growth is used to demonstrate the accuracy of the fitting code and to elucidate shifts in the shape of the DNA histogram as a function of the fraction of cells in the DNA synthesis phase. A new electronic cell sorter is described with emphasis on new features that insure simplicity, reliability, ease of operation, flexibility, and efficiency. Future directions of both technological development and biomedical applications are considered. (auth)

17996 (UR-3490-354) BIOLOGICAL IMPLICATIONS OF THE ADOLESCENT GROWTH PROCESS: BODY COMPOSITION. Forbes, G. B. (Rochester Univ., N. Y. (USA). School of Medicine and Dentistry). 1973. 17p. (CONF-730675-1). Dep. NTIS $3.00.

From NIH symposium on adolescent nutrition; Warrenton, Virginia, USA (Jun 1973).

The adolescent growth curve for total-body potassium, as determined by potassium-40 counting, is described. Since this is a function of the lean body mass, this curve permits estimates of increments in body Ca and N contents. A new mathematical model is proposed in which the adolescent spurt is considered to be superimposed on a pre-adolescent growth pattern. (auth)

Materials

17997 (BNL-18316) MAGNETIC ORDERING AND HYPERFINE PARAMETERS IN THE LINEAR CHAIN COMPOUND $RbFeBr_3$. Eibschuetz, M.; Davidson, G. R.; Cox, D. E. (Bell Telephone Labs., Inc., Murray Hill, N. J. (USA); Brookhaven National Lab., Upton, N. Y. (USA)). 1972. 5p. (CONF-731104-12). Dep. NTIS $3.00.

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

Neutron-diffraction and Mössbauer effect measurements on $RbFeBr_3$ have revealed a low-temperature magnetically ordered state ($T_N \approx 5.5°K$) with almost zero hyperfine magnetic field at the ^{57}Fe nucleus. Neutron-diffraction data taken at 150°K show that the compound has the $CsNiCl_3$ structure with space group $P6_3/mmc$, in which the Fe^{2+} ions are arranged in linear chains parallel to the hexagonal c-axis. At 20°K superlattice reflections are present which are consistent with a crystallographic transformation to the lower symmetry space group $P6_3/cm$. The new unit cell edges are $a' = a\sqrt{3}$, $c' = c$ in terms of the $P6_3/mmc$ cell, and the Fe^{2+} ions now occupy two sets of nonequivalent octahedral sites in the ratio 2:1. (auth)

17998 (CALT-822-58) EFFECT OF MANGANESE AND PHOSPHORUS CONCENTRATION ON THE ATOMIC DISTRIBUTION FUNCTION OF AMORPHOUS Pd-Mn-P ALLOYS. Marzwell, N. I. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Jan 1974. Contract AT(04-3)-822. 40p. Dep. NTIS $4.00.

The influence of composition on the structure of amorphous Pd-Mn-P prepared by a rapid-quenching technique was investigated in terms of the phosphorus concentration in $(Pd_{70}Mn_{30})_{100-y}P_y$, where $18 < y < 25$, and the transition metal content in $(Pd_{100-x}Mn_x)_{77}P_{23}$, where $15 < x < 37$. Functions that convey quantitative information about the structure were determined and compared with similar ones generated by computer-simulated Monte Carlo random statistical distribution of hard spheres. As a result, several possible "structural parameters" are proposed such as: the degree of short-range order, the affinity between metal-metal and metal-phosphorus, and the number of nearest neighbors. It is shown that the degree of disorder increases from Ni to Mn at a constant phosphorus content. Similar behavior is observed with increase in the phosphorus concentration at a constant transition-metal concentration. (15 figures, 27 references) (auth)

17999 (CEA-R-4528) EFFECT OF HYDROGEN ON THE BEHAVIOR OF METALS. II. Hydrogen Embrittlement of Titanium Alloy TV13CA: Effect of Oxygen; Comparison With Nonalloyed Titanium. Arditty, J. P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Nov 1973. 194p. (In French). Dep. NTIS (U. S. Sales Only) $11.75.

Thesis. Submitted to Strasbourg Univ. (France).

The effects of oxygen on hydrogen embrittlement of nonalloyed titanium and the metastable β-titanium alloy, TV13CA, were studied during dynamic mechanical tests, the concentrations considered varying from 1000 to 5000 ppM (oxygen) and from 0 to 5000 ppM (hydrogen) respectively. TV13CA alloy has a very high solubility for hydrogen. The establishment of a temperature range and a rate of deformation region in which the embrittlement of the alloy is maximum leads to the conclusion that an embrittlement mechanism occurs involving the dragging and accumulation of hydrogen by dislocations. This is the case for all annealings effected in the medium temperature range, which, by favoring the re-establishment of the stable two-phase $\alpha + \beta$ state of the alloy, produce hardening. The same is true for oxygen which, in addition to hardening the alloy by solid-solution effects, tends to increase its instability and, in consequence, favors the decomposition of the β phase. Oxygen concentrations of up to 1500 ppM contribute to increasing the mechanical resistance without catastrophically reducing the deformation capacity. In the case of nonalloyed titanium, the hardening effect also leads to an increase in $E_{0.2\%}$ and R, and to a reduction in the deformation capacity. Hydrogen is only very slightly soluble at room temperature, and a distribution of the hydride phase linked to the thermal history of the sample predominates. Thus, a fine acicular structure obtained from the β phase by quenching enables an alloy having a good mechanical resistance to be conserved even when large quantities of hydrogen are present; the deformation capacity remains small. When the hydride phase separates the metallic phase into large grains, a very small elongation leads to a breakdown in mechanical resistance. (auth)

18000 (CONF-731104-11) MOESSBAUER STUDY OF ORIENTED $YbCrO_3$ POWDER. Davidson, G. R.; Dunlap, B. D.; Eibschuetz, van Uitert, L. G. (Argonne National Lab., Ill. (USA)). 1973. 6p. Dep. NTIS $3.00.

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

The ^{170}Yb Mössbauer effect was used to study the local susceptibility α_{ij} of Yb^{3+} ions in the orthorhombic weak ferromagnet $YbCrO_3$ at 4.2°K. By applying an external field $\vec{H}$ to a loosely packed powder absorber, $YbCrO_3$ crystallites were oriented so that each had its weak ferromagnetic a-axis parallel to $\vec{H}$. Absorption spectra then yielded the direction z of the EFG principal axis: z lies in the a-b plane at an angle of $25 \pm 1°$ to the a-axis. For $H \leq 6$ kOe, the component of the magnetic hyperfine field parallel to z increases in magnitude linearly with H: $|H_z^{hf}| = (56 \pm 12) + (40 \pm 6)$ H, with both H_z^{hf} and H in kOe. This linear dependence is interpreted in terms of an effective-field model. By combining the results with published single-crystal magnetization data, the off-diagonal component α_{ab} of the Yb^{3+} susceptibility is estimated to be $\pm (15 \pm 13) \times 10^{-6}\ \mu_B$/Oe. This value is shown to be consistent with expectations for a ground state that is predominantly a $|\pm 7/2\rangle$ Kramers' doublet. Results of measurements in zero external field at 4.2 and 77.4°K are also reported. (auth)

18001 (COO-1198-1029) INTERNAL FRICTION IN INTRINSIC AND N-TYPE GERMANIUM AND SILICON. Gerk, A. P. (Illinois Univ., Urbana (USA)). Feb 1974. Contract AT(11-1)-1198. 122p. Dep. NTIS $8.25.

Thesis.

The high-temperature internal friction of germanium and silicon, intrinsic and highly n-type, was measured as a function of temperature, frequency, dislocation density, and dopant concentration. Two features found in the internal-friction spectrum were investigated. At moderate temperatures in both materials, when not too highly doped, there appears a peak, the features of which are independent of dislocation density, due to the acousto-electric effect. The high-temperature dislocation-dependent damping in intrinsic and intrinsic-behaving germanium and silicon was found to agree well with most previous studies. If deformed at high temperature and allowed to anneal, highly doped, n-type material behaved intrinsically due to preferential precipitation at dislocations. If deformed at minimum temperatures and not allowed to anneal, a greatly enhanced dislocation-dependent internal friction was found that depended upon the extrinsic carrier concentration. (23 figures, 93 references) (DLC)

18002 (COO-1198-1031) HYPERFINE INTERACTIONS IN FERRITES AND ORTHOFERRITES AT HIGH PRESSURE. Halasa, N. A. (Illinois Univ., Urbana (USA)). Feb 1974. Contract AT(11-1)-1198. 102p. Dep. NTIS $7.25.

Thesis.

Moessbauer spectroscopy was used to investigate the high-pressure dependence of nuclear hyperfine interactions in magnetic insulators up to 140 kbar. Four orthoferrites, nickel ferrite, and magnetite were considered in this study. (DLC)

18003 (COO-1591-24) IMPURITY EFFECTS ON THE CREEP OF POLYCRYSTALLINE MAGNESIUM AND ALUMINUM OXIDES AT ELEVATED TEMPERATURES. Technical Progress Report, December 19, 1972–December 18, 1973. Gordon, R. S. (Utah Univ., Salt Lake City (USA). Div. of Materials Science and Engineering). 1973. Contract AT(11-1)-1591. 28p. Dep. NTIS $3.00.

Nabarro–Herring creep was conclusively identified as the mechanism for the creep in oxygen of polycrystalline MgO doped with 0.53 cation % iron or less. At higher dopant levels both Nabarro–Herring creep and Coble creep contribute to creep deformation in air. An analytical procedure was developed to estimate from the creep data of polycrystalline, iron-doped MgO diffusion constants for Mg and O grain boundary diffusion and Mg lattice diffusion. The creep in air at 1500°C of coarse-grained iron-doped, (0.53 cation %) polycrystalline MgO consists of (a) viscous, Nabarro–Herring creep and (b) a nonviscous dislocation process that is independent of grain size. Nabarro–Herring creep was identified in pure polycrystalline Al_2O_3. In iron-doped (1 cation %), polycrystalline Al_2O_3 both Nabarro–Herring and Coble diffusional creep processes contribute to creep deformation. (auth)

18004 (COO-1676-29) INTERNAL FRICTION OF FERROUS MARTENSITES. Klems, G. J.; Miner, R. E.; Hultgren, F. A.; Gibala, R. (Republic Steel Corp., Cleveland, Ohio (USA); Case Western Reserve Univ., Cleveland, Ohio (USA)). 31 Oct 1973. Contract AT(11-1)-1676. 11p. (CONF-730844-2). Dep. NTIS $3.00.

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973).

An analysis of data on martensites in Fe–Ni–C, Fe–C, and Fe–Si–C alloys is presented. Results show that two distinct internal friction peaks occur in ferrous martensites which contain carbon. One relaxation peak at ~160°C at ~1 Hz is associated with twin boundary–carbon interaction; the other is a cold-work-type peak at ~250°C at ~1 Hz, and is associated with dislocation–carbon interaction. Identification of the appropriate mechanisms of these peaks has been accomplished by detailed correlation of the peak characteristics with martensite structure, martensite morphology, and carbon precipitation behavior. (JRD)

18005 (COO-2166-15) STUDY OF GRAIN-BOUNDARY SEGREGATION USING THE AUGER ELECTRON EMISSION TECHNIQUE. Annual Technical Progress Report, III, January 1, 1973–December 31, 1973. Stein, D. F.; Heldt, L. A. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1973. Contract AT(11-1)-2166. 13p. Dep. NTIS $3.00.

In Al_2O_3, it was found that additives segregated to grain boundaries. The role of additives on the densification of Al_2O_3 and MgO was measured. Segregation of S in Ni, P in W, and Bi in Cu was measured. Work continued on the effect of third element additions for controlling deterioration of properties and on intergranular corrosion in stainless steels. (DLC)

18006 (COO-2296-3) NATURE OF SIMULTANEOUS PROCESSES IN PLASTIC DEFORMATION. Li, J. C. M. (Rochester Univ., N. Y. (USA). Dept. of Mechanical and Aerospace Sciences). 1972. 20p. (CONF-7210112-1). Dep. NTIS $3.00.

From rete processes in plastic deformation conference; Cleveland, Ohio, USA (16 Oct 1972).

The nature of two simultaneous processes is analyzed in detail. It is found that the experimental activation enthalpy increases with temperature for parallel processes and decreases with temperature for consecutive processes. Similarly the activation volume increases with pressure for consecutive processes and decreases with pressure for parallel processes. The creep rate stress exponent increases with stress for parallel processes and decreases with stress for consecutive processes. Each activation parameter is the weighted average of the corresponding ones for the individual processes. Several ways are indicated for the determination of individual activation parameters. The nature of three and four simultaneous processes is discussed briefly. When several processes are operating simultaneously, one of them may be rate controlling under certain conditions. This rate-controlling process may change with deformation parameters and a "transition" can be defined. The relation between transition parameters and the construction of deformation mechanism diagrams are also discussed. (auth)

18007 (COO-3027-16) EXPERIMENTAL DETERMINATION OF THE CRITICAL POINT AND HIGH-TEMPERATURE SATURATED PHASE DENSITIES OF RUBIDIUM. Chung, J. W.; Bonilla, C. F. (Columbia Univ., New York (USA). Liquid Metals Research Lab.). 1972. Contract AT(30-1)-2660. 185p. Dep. NTIS $11.25.

Thesis.

A cylindrical capsule partially filled with rubidium metal was hung from transverse knife edges in the plane normal to the axis of the capsule at its center. The equilibrium rest angle of the capsule was measured at various temperatures until it reached the horizontal position, at which the rubidium inside the capsule was in one phase. The rest angle at a given temperature is a function of the saturated vapor and liquid densities, and is solved simultaneously with the rest angle of another capsule containing a different mass of rubidium metal, at, or interpolated to, the same temperature. The saturated phase densities are obtained, by extrapolation, up to the critical point. The critical temperature obtained was 3331 ± 10°F and the critical density 0.347 g/cm³ ± 0.5%. Combined with the critical pressure of 1943 psia obtained previously, the critical compressibility factor was calculated as 0.189 ± 0.001. (auth)

18008 (COO-3151-19) LOW-TEMPERATURE SPECIFIC HEAT AND THERMAL CONDUCTIVITY OF NONCRYSTALLINE DIELECTRIC SOLIDS. Stephens, R. B. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Mar 1973. 36p. Dep. NTIS $4.00.

The specific heats and thermal conductivities of amorphous As_2S_3, B_2O_3, $3SiO_2 \cdot Na_2O$, $CaK(NO_3)_3$, GeO_2, and Ge #7031 Varnish were measured between 0.05 and 2°K. The properties were found to be very similar to those of previously measured glasses: SiO_2, Pyrex, BeF_2, Se, PMMA, PS, Lexan, and Glycerol. They all have a specific heat $C_v = c_1T + c_3T^3$, where c_1 varies from 7 to 50 erg/g°K, and c_3 from 1.2 to $3c_{Deb}$ depending on the material (c_{Deb} is the coefficient calculated with the Debye model). They also all have a conductivity, for $T \gtrsim 0.5$°K, of $\kappa = \beta(T/\text{deg K})^\delta$ where β varies from 1.6 to 16 Watt/cm°K, and the exponent δ spans the range 1.9 ± 0.1. This uniformity of thermal properties among the diverse group of glasses measured is as difficult to explain as their temperature dependence, and is so far not understood. (auth)

18009 (LBL-2269) ELECTRONIC STRUCTURE OF NARROW-GAP SEMICONDUCTORS. Cohen, M. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 36p. (CONF-730975-1). Dep. NTIS $4.00.

From international conference on the physics of semimetals and narrow-gap semiconductors; Nice, France (10 Sep 1973).

Recent theoretical progress related to the one-electron theory of the electronic structure of several IV–VI and II–VI compounds and alloys are discussed. Some of the superconducting properties are also analyzed. (auth)

18010 (ORO-3674-5) MAGNETIC PHENOMENA AT METAL SURFACES. Final Report, 1 January 1971–31 March 1973. Spooner, S. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 1973. Contract AT(40-1)-3674. 150p. Dep. NTIS $9.50.

Cobalt and cobalt-alloy thin-film-property studies were continued on the basis of planar torque magnetometer measurements. Highly anisotropic $FeCO_3$ was studied with elastic and inelastic neutron-scattering experiments. Magnon–phonon interactions and a crystal-field-modulation effect were found. (DLC)

18011 (SGAE-2158) COMPARISON OF OUTGASSING RATES FROM STAINLESS STEEL, ALUMINUM, AND COPPER AFTER BAKEOUT UNDER HIGH VACUUM AND ATMOSPHERIC PRESSURE. Dobrozemsky, R.; Morsw, G. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Aug 1973. 13p. (CONF-730954-1). Dep. NTIS (U. S. Sales Only) $3.00.

Outgassing rates of vacuum vessels consisting of stainless steel, copper, and aluminum (inside surface area 7500 cm^2) at 25°C were measured after bakeout at 50 to 150°C (up to 250°C for s.s.). For stainless steel the outgassing rates obtained after vacuum bakeout (about 1×10^{-12} torr liters/s cm^2) agree well with those found by other investigators. Similar values were found for copper. Much lower values of the outgassing rates were obtained for aluminum (0.3 to 1.8×10^{-13} torr liters/s cm^2). The outgassing rates obtained after a 2-h bakeout in air at atmospheric pressure followed by a 18-h vacuum bakeout are significantly lower than those after a vacuum bakeout; in the case of stainless steel an air bakeout gives a permanent reduction of the outgassing rate. (auth)

18012 (SLA-73-568) THERMAL COMPRESSION BONDING OF COPPER. Sylvester, R. T.; Albright, C. E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1973. 21p. Dep. NTIS $3.25.

Copper can be bonded, with no deformation, at pressures much lower than those previously observed, provided the temperature is adequate for diffusion and the surfaces have good intimacy, with minimal surface contamination. (auth)

18013 (SLA-73-1032) IMPROVED QUALITY GSC-4 SEALING GLASS. Eagan, R. J.; Shelby, J. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 14p. Dep. NTIS $3.00.

A glass commonly used to make graded seals between fused silica and higher-expansion glasses, General Electric Company GSC-4, was remelted to obtain higher quality glass than is available commercially. Remelting the commercially available glass cane in a platinum crucible at 1700°C for periods of 40 to 60 hours produced a homogeneous glass free of crystalline inclusions and bubbles. During this melting, water was evolved and some constituents were lost from the surface layer. The bulk composition was not substantially changed and the remelted glass had approximately the same thermal expansion coefficient and viscosity as the original glass. (auth)

18014 (SLA-73-1093) HIGH PERFORMANCE ADVANCED COMPOSITE SPHERICAL PRESSURE VESSELS. Gerstle, F. P. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 36p. Dep. NTIS $4.00.

Data on a variety of advanced metal-lined filament-wound composite vessels are presented and used to corroborate ar analysis of vessel behavior. The maximum strain criterion of St. Venant is seen to be the most applicable in predicting vessel failure. Vessel burst pressure may be significantly increased by the use of higher modulus resin matrices. Expressions are developed for the composite wall thickness which produces the highest performance for a given liner/composite combination, and are numerically evaluated for aluminum liners used in conjunction with epoxy matrix composites of Kevlar and Thornel fibers. (DLC)

18015 (UCID-16401) FATIGUE OF WELDED 5083 ALUMINUM ALLOY. Hanafee, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1973. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

A failure analysis was conducted on an aluminum (5083) structure subjected to fatigue testing. Failure occurred by fatigue in an electron-beam weld; the cycles to failure were reasonable for the loading conditions. (5 figures) (auth)

18016 (UCID-16412) PREPARATION AND TESTING OF URETHANE POLYMER RINGS. Buckner, A. T.; Jessop, E. S.; Hammon, H. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1973. Contract W-7405-eng-48. 8p. Dep. NTIS $3.00.

Procedures and apparatus are described for cutting and tensile testing of urethane rings. (DLC)

18017 (UCR-34-P-77-38) ANNUAL REPORT. Everett, G. E. (California Univ., Riverside (USA)). 1973. Contract AT(04-3)-34. 165p. Dep. NTIS $10.25.

Eight preprints and internal reports are presented for: magnetic properties of europium chalogenides, microwave resonance in $CrCl_3$, synthesis and magnetic characterization of GdN, and magnetic susceptibility of Sm_2Te_3. (DLC)

Physics

18018 (CONF-731209-1) MODEL FOR SUSPENSION AND ATMOSPHERIC TRANSPORT OF DUST. Mills, M. T.; Olson, J. S. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.; USAEC Division of Biomedical and Environmental Research, Washington, D. C.). 1973. 37p. Dep. NTIS $4.00.

From meeting of the American Geophysical Union; San Francisco, California, USA (10 Dec 1973).

A computer model was developed that treats the suspension and subsequent atmospheric transport of fine dust particles as a process initiated by the saltation of sand-sized grains. (auth)

18019 (COO-3352-5) THERMAL NEUTRON SCATTERING STUDIES OF MOLECULAR DYNAMICS AND CRITICAL PHENOMENA IN FLUIDS AND SOLIDS. Annual Progress Report, December 1972–November 1973. Chen, S. H. (Massachusetts Inst. of Tech., Cambridge (USA)). 1973. Contract AT(11-1)-3352. 11p. Dep. NTIS $3.00.

Results of research on quasielastic scattering in dense gases are reported. Results of dynamic structure factor measurements in liquid Ga are also reported. Work directed toward development for high resolution light scattering spectroscopy is summarized. (JRD)

18020 (LA-5131) PRESSURE MEASUREMENTS ON THE SHOCK-INDUCED DECOMPOSITION OF HIGH-DENSITY PETN. Wackerle, J.; Johnson, J. O. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 23p. Dep. NTIS $4.00.

18021 (LBL-2444) DISPERSION OF GASEOUS EMISSIONS FROM A GROUND-LEVEL LINE SOURCE. Winges, K. D.; Grens II, E. A.; Vermeulen, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 19 Nov 1973. Contract W-7405-eng-48. 97p. NTIS $7.00

Thesis. Submitted by K. D. Winges.

From the standpoint both of health hazards and of the photochemical smog-forming reactions, dispersion effects near the emission source may be highly significant. Therefore, this study considers the spread of pollutants in the vicinity of a ground-level emission source, the immediate objective being concentration plots at distances within a few feet from the source. (16 figures, 54 references) (MCW)

18022 (MLM-2119(TR)) APPROXIMATE SOLUTIONS FOR THE SHAPE OF NUCLEAR MAGNETIC SIGNALS IN PULSE EXPERIMENTS IN SOLIDS. Siegle, G. Translated from Z. Naturforsch.; 23a: 1194-1201(1968). 20p. Dep. NTIS $3.00.

NMR transients in solids have been calculated using the method of Lowe and Norberg and its extension by Powles and Strange. (DLC)

18023 (MLM-2120(TR)) NUCLEAR MAGNETIC RESONANCE SIGNALS IN SOLIDS WITH TWO DIFFERENT SPIN TYPES. Siegle, G. Translated from Z. Naturforsch.; 23a: 556-562(1968). 16p. Dep. NTIS $3.00.

If the phases of the modulation of two 90° pulses differ by 0° or 90°, the sum of the echo amplitudes in certain cases agree with the shape of the free-induction decay after a single pulse. If the spins fluctuate rapidly, the echo amplitudes show a strong dependence on the external Zeeman field and temperature. (DLC)

18024 (MLM-2121(TR)) LAWS OF FORMATION OF THE NUCLEAR SIGNALS IN SOLIDS IN PULSE EXPERIMENTS. Siegle, G. Translated from Z. Naturforsch.; 23a: 91-100(1968). 22p. Dep. NTIS $3.25.

Free induction transient signals in nuclear magnetic resonance are calculated for solids, extending the method of Lowe and Norberg (Phys. Rev., 107: 46(1957)) to several pulses. (DLC)

18025 (SLA-73-777) ELECTROOPTIC DEVICES UTILIZING QUADRATIC PLZT CERAMIC ELEMENTS. Cutchen, J. T.; Harris, J. O. Jr.; Laguna, G. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1973. 17p. (CONF-730969-1). Dep. NTIS $3.00.

From western electronic show and convention on ferroelectric ceramic electrooptic devices; San Francisco, California, USA (13 Sep 1973).

A number of operational electronic devices are described that utilize PLZT ceramics as the active electro-optic element. For this study, the PLZT ceramic composition was maintained at a constant 65/35 Zr/Ti ratio, with the La content ranging from 8.5 to 12 atomic percent. When operated in the transverse birefringent mode, these materials exhibit the quadratic, or Kerr, electro-optic effect. Typical applications discussed include flash-blindness protective devices (to protect personnel as well as light-sensitive instruments such as image intensifiers and vidicon tubes), display devices, page composers for holographic memories, and light gates for a variety of shutter applications. Contrast ratios and lifetime effects are discussed for the page-composer application. (22 figures, 27 references) (auth)

18026 (SLA-73-8014) TEMPERATURE MEASUREMENT IN A HIGH-TEMPERATURE CARBON MULTILAYER REENTRY VEHICLE HEATSHIELD. Wright, G. R. Jr.; Beard, S. G. Jr.; McVey, D. F. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 7p. (CONF-731106-3). Dep. NTIS $3.00.

From thirteenth international conference on thermal conductivity; Lake Ozark, Missouri, USA (5 Nov 1973).

During recent flight tests, temperatures in a carbon/carbon heat shield consisting of a carbon composite ablator and carbon insulator over a metallic substructure were measured. To obtain reliable temperature data, the thermal sensors used on these flights were required to (1) operate over a range of temperatures from 300 K to approximately 2200 K, (2) remain operational throughout the time of significant aerodynamic heating which was less than one minute, (3) respond to rates of temperature increase of the order of 10^3K/s, (4) measure material interface temperatures for comparison with computed values, (5) match the thermal cross section of the insulator as closely as possible, and (6) reduce or prevent chemical reactions between thermocouple junctions and the high temperature carbon. A thermal sensor that meets the above requirements is described. A comparison between temperatures measured with the sensor and the computed values is presented. (auth)

18027 (UCRL-75194) RECENT STUDIES OF THE SUSPENSION OF DESERT DUST AND RESUSPENSION OF TOXIC AEROSOL DUE TO WIND. Porch, W. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1973. 21p. Dep. NTIS $3.25.

Recent studies of the suspension of desert dust indicate that the resuspension process in the desert can occur in association with comparatively low-velocity average winds with a diurnal pattern. (auth)

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